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Workstation Segment Specification for the World-Wide Military Command and Control (WWMCCS) Information System (WIS)

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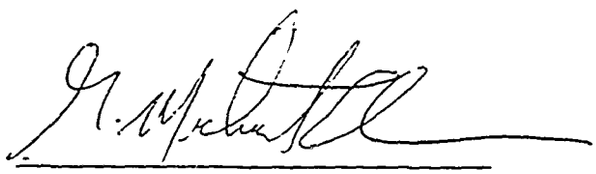

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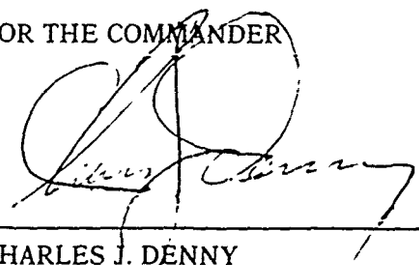

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This paper contains the A-level specification that was included in the RFP package for a series of new World-Wide Military Command and Control System (WWMCCS) Information System (WIS) Workstations, WIS-SPEC-601. This specification has been developed to support the ongoing procurement of workstation products necessary to meet the operational needs of the WIS community. Included within the specification are two workstation configurations (Basic and Target Workstations) as well as support peripherals such as printers and displays. Basic software capabilities required to support WWMCCS host access, WIS LAN access, and provide personal computer support are also described.

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WORKSTATION SEGMENT SPECIFICATION

FOR THE

WORLD-WIDE MILITARY COMMAND AND CONTROL (WWMCCS)

INFORMATION SYSTEM (WIS)

F19628-88-R-0038
Section J, Item 2

14 November 1988

FOREWORD

This paper contains the Segment Specification for a series of new World-Wide Military Command and Control System (WWMCCS) Information System (WIS) Workstations. This specification has been developed to support the ongoing procurement of workstation products necessary to meet the operational needs of the WIS community. Included within the document are two workstation configurations (Basic and Target) as well as support peripherals including printers and displays. Fundamental software capabilities in the areas of operating system, application development, and user support software are also described.

This specification is a "living document," capturing the requirements of the workstation in their totality as they evolve as part of the overall WIS design process. The sections of the specification that contain "GRAY" in their titles represent requirements which are expected to be levied on the WIS Workstation hardware and software eventually, and which indicate the general thrust of evolution and growth capabilities required of the workstation segment. These GRAY sections should be considered as descriptions of additional candidate development and/or procurement activities that, with a high degree of probability, will be activated during the course of the WIS Workstation procurement period.

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1. SCOPE

1.1. Identification

This System Segment Specification establishes requirements for the Workstation Segment for the World-Wide Military Command and Control System (WWMCCS) Information System (WIS). Requirements for workstations and associated peripheral equipment that provide compatibility with WIS Block A Release 1 system design and implementation, support development of the WIS Block B system design and implementation, and meet future WIS needs are described by this Specification.

1.2. Purpose of the WIS Workstation

Background material is presented in this section to provide a framework for the delineation of the requirements contained in Section 3. Information about the mission of WIS, and the role that the workstation will play in accomplishing that mission are discussed in the following paragraphs.

1.2.1. WIS Program Objectives

The intent of the WIS program is to provide an improved Command and Control (C^2) capability for use in national security decision-making, force preparation and planning, and execution of operation plans, by modernizing the WWMCCS Automated Data Processing (ADP) system primarily through the use of Proven Non-Developmental Item (NDI) hardware and software. The improvements will be directed toward providing an enhanced user interface to the WIS environment, extended growth capabilities, better response time, enhanced system reliability and survivability, as well as enhanced configuration control over the evolution of the system.

The transition from the WWMCCS Standard ADP system to WIS will be gradual and will be fielded in increments denoted as Blocks based on user priority, technological achievability, degree of requirements definition, graceful transition, cost effectiveness, and affordability. The WIS planning for transition takes into consideration such user concerns as: (1) the ability to provide support in crisis and conflicts, (2) the early availability of enhanced features, (3) the uninterrupted continuity of day-to-day operations, and (4) the operational problems created by introducing additional ADP equipment at a site.

1.2.2. WIS Program Requirements Definition

Requirements for the WIS program needed to support the WIS mission are derived from several Organization of the Joint Chiefs of Staff (OJCS) approved documents citing the Required Operational Capability (ROC) to be supported. These ROCs and other documents that define WIS requirements include but are not limited to:

a. WWMCCS ADP Concept of Operations and General Requirements for Post-1985,
b. WIS Joint Mission Element Needs Statement (JMENS),
c. JCS Pub 19 WWMCCS Standard Systems,
d. JCS Pub 6-03.7 Security Policy for the WWMCCS Intercomputer Network
e. Joint Operation Planning and Execution System (JOPES) ROC,
f. National Military Command System (NMCS) Information System (NIS) ROC,
g. Automated Message Handler (AMH) MROC,
h. Host-Automated Message Interface (H-AMI) Functional Description,

i. JOPES Concept of Operations,
j. JOPES Increment 1 Functional Description (FD),
k. JOPES Data Requirements Document,
l. WIS Program System Description, and
m. Decision Coordinating Paper (DCP) for the Worldwide Military Command and Control System (WWMCCS) Information System (WIS).

1.2.3. WIS Program Structure

The WIS program is currently defined in three Blocks designated A, B, and C. Incremental deliveries within a Block are referred to as releases. Block A will be delivered in one release (Release 1) that provides a backbone structure for further WIS growth. Block B is being planned to consist of several releases that will achieve early delivery of Joint Operational Planning and Execution System (JOPES) operational capabilities to users. Block C planning has not yet been undertaken, but, will complete the transition from WWMCCS Standard ADP to JOPES and related systems, as well as integrate advanced technology to further assist operational planning activities.

Figure 1 provides an overview of the WIS architecture, and identifies the primary components of the WIS.

1.2.3.1. Block A WIS

Block A WIS development is to provide a system that supplies the following capabilities to the current WWMCCS user community:

a. The capability to access WWMCCS and WIS resources through the use of a Local Area Network (LAN). The LAN will provide a common backbone for local (intra-site) communications among various WIS resources, as well as provide a portal for access to remote WIS/WWMCCS equipment.

b. The capability to access the current WWMCCS standard ADP systems and new WIS systems by use of a standard WIS Workstation connected to the WIS LAN, and, in the case of the existing WWMCCS ADP equipment, through direct connections to the WWMCCS equipment from the WIS Workstation.

c. An interface to the Defense Data Network (DDN) through special LAN gateways and made accessible to the user from the WIS Workstation. DDN provides long-haul digital data transmission services for the DoD community. DDN will provide inter-site data transmission services for WIS.

d. An interface to the Automated Digital Network (AUTODIN) for formal message transmittal and reception, via the WIS Automated Message Handling (AMH) Segment and the WIS Workstation Segment.

e. Support for AUTODIN text message generation and receipt, including automatic routing to users with access to a WIS workstation based on pre-stored interest area profiles.

f. A stand-alone mode, providing personal computer capabilities (spreadsheet, BASIC language, word processing, data base management, and graphics).

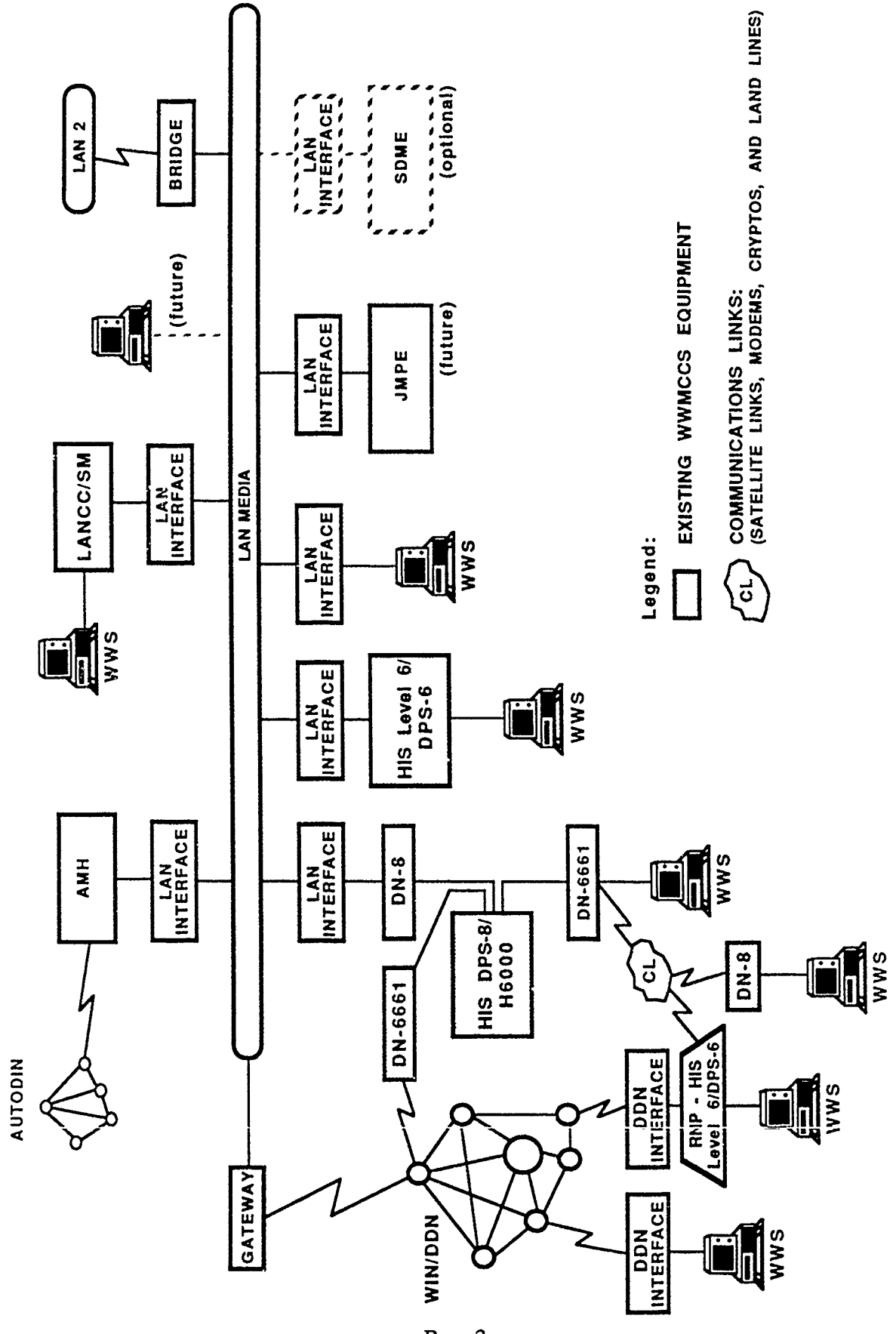

Figure 1 - WIS ARCHITECTURE OVERVIEW

When installed, the Block A will provide much of the essential hardware and many of the target software attributes of the completed WIS system. Subsequent block releases will build upon the foundation provided by Block A to meet the final requirements WIS.

1.2.3.2. Block B WIS

The primary objective of Block B development is the deployment of Joint Operations Planning and Execution System (JOPES) Increment 1 capabilities, as defined in the JOPES ROC and JOPES Increment 1 Functional Description (FD). WIS Block B will provide these capabilities through the acquisition of several Block B segments. These segments include the Joint Mission Software (JMS), Joint Mission Processing Environment (JMPE), WIS Workstations (WWS) upgrades, Automated Message Handler (AMH) upgrades, and Local Area Network (LAN) upgrades. The following major capabilities will be provided as part of the acquisition and development of these Block B segments :

a. Joint Mission Applications and Modeling Software that directly supports specific joint C^2 tasks and procedures, including strategy development, courses of action planning, execution planning, implementation, and monitoring.

b. Joint Mission Processing Environment hardware and system software resources required to support the execution of the Joint Mission and Mission Support software, as well as provide joint WWMCCS database support facilities.

c. Local Area Network and System Communications upgrades to provide a limited multi-level secure mode level of operation, as well as enhanced protocols and performance.

d. A Data Base Management Facility (DBMF) which, as part of the JMPE, interfaces with the Joint Mission Applications Software and supports access by users and processes at the local site and other WIS sites.

e. Automated Message Handler upgrades, which include hardware and software upgrades to increase functionality, the inclusion of a capability to handle AUTODIN data pattern traffic, and the inclusion of the ability to generate, process, and distribute Joint Interoperability Tactical Command and Control System (JINTACCS) messages.

f. WIS Workstation (WWS) upgrades which include WIS Workstation hardware and software upgrades, as well as support for advanced graphics processing and other computationally intensive tasks.

1.2.3.3. Block C WIS

Block C objectives have not been formally developed at this time. However, the general goals of Block C WIS include the following major objectives:

a. Completion of the development of JOPES as will be defined in Increment 2.

b. Investigation of other technologies such as advanced simulation and modelling technology, and artificial intelligence and expert system technology to further support the operational planning community.

c. Support for the generation and reception of operation planning and execution information, and the coordination of joint actions with allied countries (e.g., NATO).

d. Implementation of full multi-level secure operations at WIS sites to allow various users with differing security clearances and need-to-know privileges access to WIS-based information necessary for execution of their jobs without compromising the security integrity of other information contained within the system.

1.2.4. The Role of the Workstation Segment in WIS

As can be seen from examining Figure 1, the WIS Workstation (WWS) Segment provides the WIS user's primary means of communication with the Automated Message Handling (AMH) system, the WWMCCS Honeywell ADP host systems, the Joint Mission Processing Environment (JMPE) host systems, and any Site/Command Unique (S/CU) host environments included as part of a specific site's WIS configuration. The WIS Workstation Segment will also provide a spectrum of processing capabilities, ranging from user support functions such as word processing, spreadsheet calculation, and local database management, to graphics generation functions. The WIS Workstation Segment will also provide the processing environment (hardware and system software) that will support advanced workstation functions such as simulation, modelling, and the employment of artificial intelligence techniques that will be used in the future to further aid the planning and operations communities.

1.2.5. Capabilities of the WIS Workstation Segment

To perform the role described in the previous paragraphs, the WIS Workstation Segment must provide the following capabilities and services:

a. Host Access Services,
b. System and Application Development Support Services,
c. User Support Services,
d. Advanced Computational Support Services.

1.2.5.1. Host Access Services

The WIS Workstation Segment will provide the WIS user the means to access the various host resources that comprise the other major components of WIS. These host resources include the following:

a. WWMCCS Hosts (Honeywell H6000, DPS-8, and DPS-6 computers),
b. Automated Message Handling System (AMH),
c. Joint Mission Processing Environment (to be determined),
d. Service/Command Unique Processing Environments.

1.2.5.2. System and Application Development Support Services

The WIS Workstation is a major processing resource of the WIS, and the architecture of the workstation will be constructed so that workstation environment can be used to support the development and execution of the distributed applications envisioned for WIS. To support this role as a major computational resource of the distributed WIS environment, the workstation segment will provide a standardized operating environment that will ease the burden of using workstation resources, and that can efficiently manage these workstation resources for the application developer. Such items as a multi-

tasking operating system, a network accessible windowing system, and a distributed file system will greatly enhance the ability of application developers to design and construct the distributed applications that will form the major processing components of WIS.

1.2.5.3. User Support Services

The WIS Workstation Segment will provide the user community with a complete personal computer environment similar to those found in the commercial sector. Capabilities for word processing and document preparation, spreadsheet calculation, database management, and graphics generation are needed by the WWMCCS community to support the user in performing day-to-day operations.

As part of the user support services function, the WIS Workstation must be able to interoperate with data files created by, and execute applications developed using components of the Early Product commercial software deployed as part of the Block A effort.

1.2.5.4. Advanced Computational Support Services

As WIS evolves, the WIS Workstation Segment will provide more and more of the computing resources required to support the numerical simulation, modelling, and other compute-intensive operations related to plan development and execution. Also, the WIS Workstation will provide the system base to support the introduction of artificial intelligence technology such as expert systems and natural language processing that will further aid and enhance the ability of the planning and operations community to plan and execute military operations. WIS Workstations need to be both flexible and expandable to support the increased demands for computational resources as the nature of these compute-intensive requirements are developed.

1.3. Purpose of this Specification

The purpose of this specification is to define and describe the requirements for WIS Workstations and peripheral equipment that will meet the needs of a variety of users within the WIS community. The specification describes two distinct classes of workstations, as well as workstation printers and other peripheral equipment.

If the WIS program were to specify a single workstation configuration that met the needs of a very diverse WIS user community, the result would the specification of a workstation too expensive for many of those users. Thus, a prudent long-range strategy would be to allow users to procure fundamental systems that met most of their needs, and a series of peripheral equipment that could be added on. As the user's requirements increased, and the user's budget permitted upgrades, the functionality of the system could be increased through the procurement of the additional peripheral equipment to more closely match the evolving needs of the user. This is the strategy being pursued for the procurement of the WIS Workstation.

This segment specification describes two workstation systems:

a. the **Basic Workstation** which provides a workstation solution for many WIS users who need to support text generation applications (message generation, document preparation, etc.), host access, and the simpler computational applications, but do not need the additional processing capabilities of the Target Workstation; and,

b. the **Target Workstation** which provides the capabilities of the Basic Workstation, as well as a sophisticated processing environment designed to meet the anticipated heavy computational needs of WIS planning applications.

The Target Workstation has been designed to support the workstation needs required for most WIS users, and is the workstation that will support the long-term evolution of the overall WIS. The Basic Workstation has been designed to provide an entry-level capability that meets most current WIS Workstation needs, and will provide a (smaller) level of support for future WIS evolution.

Complete upward and downward compatibility is being sought for these machines in order to maximize the user's investment in time, material, and software, to the extent that the Basic Workstation will be required to be completely transformable into a Target Workstation when and if the user's needs require that upgrade, and the user's budget permits the upgrade to be purchased. It is the intent of this Segment to ensure that machines are made available that meet the needs of the user at a reasonable cost without requiring the expenditure of funds on capabilities not needed; and that these machines can be upgraded to meet new needs and requirements as the nature of the user's mission changes.

Peripheral equipment has also been defined that allows overlap in capability of this series of workstations. Items such as additional disk storage, displays, and memory have been specified so that the Basic Workstation can provide capabilities similar to the Target Workstation. Hardcopy output devices including workstation printers and video printers have also been defined in this specification to provide output support for the workstation user.

This Segment Specification is structured to provide a compendium of requirements that the WIS Workstation must satisfy as the design and architecture of WIS evolve. Certain portions of the Specification have been marked as GRAY (and supplied with gray backgrounds during printing of the Specification) to indicate future growth requirements that the WIS Workstation systems must meet. Since this Specification will be used as the basis of several related procurement actions, each action will selectively "gray" and "un-gray" sections of the Specification appropriate to the action being undertaken. In addition, the procurement of the base WIS Workstation systems (hardware and software) will actively seek a set of systems that can be extended and evolved to meet the requirements contained in the GRAY areas of this Specification.

This Specification describes requirements for both the Basic and Target Workstation. Some requirements are common to both systems while others are specific to the system being described. In this specification, references to, "the Workstation", "the WIS Workstation", or "the WIS Workstations" are to be interpreted as requirements that must be met by both systems. References to systems delineated by the term "Basic" or "Target" (i.e., "the Basic Workstation", "the Basic WIS Workstation", etc.) are to be interpreted as being applied only to that delineated system (either Basic or Target).

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2. APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

2.1. Government Documents

2.1.1. SPECIFICATIONS

DCA Circular 370-P185-15 March 1988	World Wide Military Command and Control System (WWMCCS) Automated Data Processing (ADP) Standard Telecommunications Engineering Practices
WIS-ICD-002 Revision A September, 1987	WIS LAN Interface Control Document
WIS-ICD-012 March, 1988	WIS VIP/TELNET Interface Control Document
WIS-SPEC-100 1984	WIS LAN Segment Specification

2.1.2. STANDARDS

ANSI/MIL-STD 1815 Revision A January 1983	Ada Language Reference Manual
DIA DDS-2600-5502-87 Revision 1 November 1987	Requirements for System High and Compartmented Mode Workstations
DDN RFC 792 September 1981	Intercomputer Message Protocol
DDN RFC 795 September 1981	Service Mapping
DDN RFC 796 September 1981	Address Mapping
DDN RFC 821 August 1982	Simple Mail Transfer Protocol
DDN RFC 822 August 1982	Standard for the Format of ARPA-Internet Text Messages
DDN RFC 826 August 1982	An ETHERNET Address Resolution Protocol (ARP)

DDN RFC 1020 November 1987	Internet Numbers
DDN RFC 1038 January 1988	Draft Revised Internet Protocol (IP) Security Option
DoD 5000.39-STD November 1983	Acquisition and Management of Integrated Logistics Support for Systems and Equipment
DoD Directive 5200.28 Revised March 1988	Security Requirements for Automated Information Systems (AIS)
DoD 5200.28-STD Revised 1987	Department of Defense Trusted Computing System Evaluation Criteria
FIPS Pub. 1-2 November 1984	Code for Information Interchange, its Representations, Subsets, and Extensions
FIPS Pub. 16-1 September 1977	Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission
FIPS Pub. 17-1 September 1977	Character Structure and Character Density Sense for Serial-by-Bit Data Communication in the Code for Information Interchange
FIPS Pub. 22-1 September 1977	Synchronous Signalling Rates Between Data Terminal and Data Data Communications Equipment
FIPS Pub. 85 November 1980	OCR Inks
FIPS Pub. 89 September 1981	OCR Character Positioning
FIPS Pub. 90 September 1983	Guideline for OCR Print Quality
FIPS Pub. 127 March 1987	Database Language SQL
FIPS Pub. 151 September 1988	POSIX; Portable Operating System Interface for Computer Environments
JCS Publication 6-03.7 April 1988	Security Policy for the WWMCCS Intercomputer Network
MIL-HDBK-217 Revision E October 1986	Reliability Prediction of Electronic Equipment

MIL-STD-129J Notice 1 November 1986	Marking for Shipment and Storage
MIL-STD-188/114 Revision A November 1976	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188 Revision C Notice 2 November 1976	Military Communication System Technical Standards
MIL-STD-280 Revision A	Miscellaneous Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-454 Revision K Notice 2 February 1987	Standard General Requirements for Electronic Equipment
MIL-STD-882 Revision B Notice 1	System Safety Program Requirements
MIL-STD-1472 Revision C Notice 1 September, 1983 Notice 2 May, 1984 Notice 3 March 1987	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
MIL-STD-1777 August 1983	Internet Protocol (IP)
MIL-STD-1778 Notice 1 October 1983	Transport Control Protocol (TCP)
MIL-STD-1780 May 1984	File Transfer Protocol
MIL-STD-1781 May 1984	Simple Mail Transfer Protocol

MIL-STD-1782 May 1984	TELNET Protocol
NACSIM 5100A July 1981	Compromising Emanations Laboratory Test Standards, Electromagnetic
NACSIM 5201 December 1980	TEMPEST Guidelines Equipment System Design
NACSIM 5203 June 1982	Guidelines for Facility Design and Red/Black Installation

2.1.3. OTHER PUBLICATIONS

NBS-IR-87-3674 January 1987	Implementation Agreements for Open System Interconnection Protocols
ESD-TR-86-278 1986	USI Guidelines

2.2. Non-Government Documents

2.2.1. SPECIFICATIONS

Honeywell Pub. AL-29 Revision 2	Visual Information Presentation (VIP) User's Manual
Gettys, Newman, Scheifler Version 11 February 1987	Xlib - C Language X Interface Protocol

2.2.2. STANDARDS

ANSI/UL 478-1979 1979	Safety Standard for Electronic Data Processing Units and Systems
ANSI X3.17-1981 1981	OCR A Font Description
ANSI X3.49-1975 Revised 1982	OCR B Font Description
ANSI X3.124-1986 April 1986	Graphical Kernel System
ANSI X3.131-1986 June 1986	Small Computer System Interface

ANSI X4.23-1982 1982	Alphanumeric Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR
EIA RS-170 Revision A November 1977	Monochrome and Color Television Studio Facilities
EIA RS-232 Revision D January 1987	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) Employing Serial Binary Data Interchange
EIA RS-422 Revision A December 1978	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA RS-423 Revision A December 1978	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits
EIA RS-449 Revision 1 February 1980	General Purpose 37 Position and 9 Position Interface for Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) Employing Serial Binary Data Interchange
ISO Standard 7498 1984	Basic Reference Model for Open Systems Interconnections
ISO Standard 8072 1984	Transport Service Definition
ISO Standard 8073 1986	Connection-Oriented Transport Protocol Specification
ISO Standard 8473 1986	Protocol for Providing the Connectionless-Mode Network Service
ISO DP 8571 1986	File Transfer, Access Management (FTAM)
ISO DP 9040 1988	Virtual Terminal Service
CCITT X.400 1984	Message and Mail Handling Protocols

2.2.3. OTHER PUBLICATIONS

IEEE 754 1985	Standard for Binary Floating Point Arithmetic

IEEE 802.3 1985	Carrier Sense Multiple Access with Collision Detection Access Method and Physical Layer Specification (10Base5)
IEEE 802.3A 1986	Baseband Medium Attachment Unit and Baseband Medium Specifications (10Base2)
IEEE 802.3B 1986	Broadband Medium Attachment Unit and Broadband Medium Specifications (10Broad36)
IEEE 802.7 1986	Broadband Local Area Network: Recommended Practices
Columbia University 1987	KERMIT Protocol Manual
NEC-1984 1984	National Electrical Code
Steele Digital Press 1984	Common LISP

3. REQUIREMENTS

3.1. System Definition

3.1.1. Mission

The goal of the WIS Workstation Segment, and of the WIS in general, is to improve command and control (C^2) staff capabilities during crisis/war situations, as well as during day-to-day, peacetime operations. The WIS Workstation hardware and software is intended to support the mission of the commander and other headquarters personnel as an integral part of the overall WIS, as described in 1.1. The mission of the WIS Workstation segment in the WIS C^2 environment is to assist in the provision of improved speed, accuracy, efficiency, and effectiveness of information handling through use of state-of-the-art workstation hardware and software technology. WIS Workstations will perform this role by providing access to other WIS-associated resources using the LAN and other means of communications, as well as providing local workstation-based computer resources to the command staff user.

3.1.2. Threats

The WIS Workstation provides a critical link in the control of access to sensitive information resident on the workstation and other components of WIS. It is imperative that the workstation provide support to protect against unauthorized tampering with data, reading of data, data destruction, and denial of authorized access to workstation-accessible data. The need to protect data resident on the WIS Workstation and data to which the WIS Workstation provides access are thus important sources of requirements for the WIS Workstation Segment Specification.

There are three aspects to this problem: physical/COMSEC security, electromagnetic radiation (TEMPEST), and data security. TEMPEST requirements are discussed in later paragraphs of this specification. The areas of physical/COMSEC security and data security are addressed in the following paragraphs.

3.1.2.1. Physical/COMSEC Protection

WIS Workstation equipment will be located in secure facilities which will provide adequate protection against physical threats to the WIS Workstation equipment. Normal security equipment tracing and auditing procedures are sufficient to protect against physical threats to the security of the WIS Workstation subsystem from both internal and external hostile agents. When it is necessary to transfer classified information across physical areas which are physically protected to less than the level of classification of the material to be transmitted, the use of government-furnished encryption units and/or government-furnished shielding will be employed for COMSEC protection. All WIS Workstations (Basic and Target) shall [1] be able to use externally attached government encryption units to provide secure transmission communications paths. All WIS Workstation (Basic and Target) shall [2] be able to use embedded encryption devices in all workstation communications subsystems that can transmit data to external devices.

3.1.2.2. Data Security

Data security will be initially provided primarily by restricting access to the WIS Workstation equipment and data media to those persons holding the appropriate clearance level and "need to know"

privileges. Data security measures provided as part of the design of the architecture of the WIS Workstation will be used in the future as WIS evolves to a multi-level secure environment to provide the primary measures of data security control. The characteristics of the data to be protected, and the level of required protection are discussed in the following sub-paragraphs.

3.1.2.2.1. Classification Level

The security level of data to which a user of the WIS Workstation can have access will range from the level of Unclassified to Top Secret. Workstation users will have clearance levels ranging from Secret to Top Secret. Top Secret workstations will normally be placed in controlled access locations so that it can be assumed that only persons cleared to the level of Top Secret will be allowed access to those workstations.

3.1.2.2.2. Operational Security Mode

The operational security mode for Block A and early Block B WIS configurations will be System High TOP SECRET, as defined in DoD 5200.28. Requirements on the hardware and operating system software contained in later paragraphs reflect the need to support a minimum of System High TOP SECRET operation.

As WIS evolves, various levels of multi-level secure operating mode will be implemented for the overall system. The operating mode for initial multi-level secure WIS configurations will be limited multi-level secure mode (i.e., "Controlled Mode"), where access to classified information resident on the system is limited to personnel cleared to one of two adjacent security levels, in the case of WIS, SECRET and TOP SECRET. Later evolution of the WIS may require an evolution to full multi-level secure control support, where all personnel are able to access data resident on the system, and the system is capable of mediating and controlling access to data based on user clearance levels and need-to-know requirements.

3.1.2.3. Overall Workstation Security Requirements

To meet the security objectives of the WIS Workstation outlined in the previous discussion, and to meet the security requirements contained in JCS Publication 6-03.7, **Security Policy for the WWMCCS Intercomputer Network,** it is necessary that the WIS Workstation hardware and software architecture and design be sufficient to meet the following general security requirements.

3.1.2.3.1. System High Workstation

Initially, in Blocks A and early Block B, it is required that the WIS Workstation support a System High level of operation. To meet this overall security need, requirements have been derived for the WIS Workstation system design and architecture from several DoD security guidelines, notably, DoD 5200.28-STD, and Defense Intelligence Agency (DIA) document DDS-2600-5502-87. These requirements have been collected and are presented in Appendix V, **Security Requirements for System High Workstations** . All WIS Workstation (Basic and Target) architectures (hardware and system software) shall [1] satisfy the requirements for System High workstations outlined in Appendix V (50.1).

3.1.2.3.2. Limited Multi-Level Secure Workstations (GRAY)

Target Block B WIS Workstations will be required to provide additional security processing to support limited multi-level secure operations for WIS. This level of security support requires that the WIS Workstation design and architecture meet the B2 evaluation criteria as specified in DoD 5200.28-STD, as well as other requirements that have been derived from DIA DDS-2600-5502-87 and collected in Appendix V, **Security Requirements for Controlled Mode Workstations** , that provide needed additional protection capabilities. The Target WIS Workstation architecture (hardware and software) shall [1] satisfy the requirements for a B2 level of trust as defined in DoD 5200.28-STD, and the compartmented mode workstation requirements contained in Appendix V (50.2).

3.1.3. System Modes and States

The WIS Workstations (Basic and Target) shall [1] support three (3) modes of operation: standalone, WWMCCS host direct connect, and LAN-connected. On all WIS Workstations (Basic and Target), all System Support Software and User Services Support Software supplied to meet requirements specified in 3.1.4.2 and 3.1.4.3 shall [2] be capable of initiation, and execute correctly when in stand-alone mode. On all WIS Workstations (Basic and Target), all Honeywell VIP emulation system software (see 3.1.4.1.2) operating over direct hardware connections to WWMCCS host equipment (including H6000, DPS-8, DPS-6, DN-8, and Level 6 systems) as well as all standalone mode software shall [3] be capable of initiation and execute correctly when in WWMCCS host direct connect mode. On all WIS Workstations (Basic and Target), application software that uses the WIS LAN interfaces, either the the X.25 based LAN interface (3.1.7.1.3.3) or the IEEE 802.3 LAN interface (3.1.7.1.3.4) depending on the WIS Workstation configuration, as well as all software available in standalone mode and WWMCCS host direct connect mode shall [4] be capable of initiation and execute correctly when in LAN-connect mode.

All WIS Workstations shall [5] contain means to switch modes from standalone to direct-connected to LAN-connected. Mode switching shall [6] be accomplished without requiring the switching of disk media, making/breaking of equipment connections, or other modifications to the physical configuration of the WIS Workstation equipment, and without requiring a re-initialization of the workstation system. Government-mandated equipment changes may be dictated by security policies, as determined by each WIS site. The ability to switch to a specific mode presupposes that physical connections required to support the mode are present at a specific workstation (e.g., WWMCCS host direct connection mode support presupposes that a physical connection exists to the WWMCCS host). The switch from one mode to any other mode shall [7] be within a period of ten (10) seconds.

3.1.4. System Functions

In this paragraph, the characteristics of the functions and capabilities the WIS Workstation must provide are presented and discussed. These functions and capabilities include:

a. Host Access Support Services,
b. System and Applications Development Support Services,
c. User Support Services, and
d. Advanced Computational Support Services.

3.1.4.1. Host Access Support Services

This paragraph of the WIS Workstation Segment Specification describes the requirements for general support of the Host Access functions required of all WIS Workstations, Basic and Target configurations. More information on the interfaces required to support WIS Host Access can be found in 3.1.7.1, **External Interfaces**.

The WIS Workstations must support a variety of host interconnection schemes due to the diversity of communications options supported by the WWMCCS and WIS systems, now, and in the future. Fundamentally, the WIS Workstations will communicate with WIS and WWMCCS host equipment using the WIS LAN (see figure 1). However, the interface to the LAN is evolving as the WIS LAN architecture evolves and matures. The WIS Workstation must be flexible enough to accommodate this WIS LAN growth and evolution process. Also, for the foreseeable future, the WIS Workstation must support a direct connection communications path between the WIS Workstation and the WWMCCS ADP host equipment. Furthermore, WIS Workstations located at remote WIS sites that do not have a WIS LAN must be capable of supporting access to a WIS LAN using the Defense Data Network (DDN) and the WIS LAN gateway to DDN, as well as access remote WWMCCS hosts using WWMCCS remote interface units (i.e., WWMCCS Level 6, DN-8, and DPS-6 systems). All of these options must be supported as part of the WIS Workstation architecture. The requirements described herein and in 3.1.7.1 are designed to provide these various communications capabilities.

3.1.4.1.1. General Host Access Requirements

All WIS Workstations (Basic and Target) shall [1] support communication over a minimum of one (1) direct connect communication path with a WWMCCS host concurrently with all required LAN connect sessions.

Workstation connections to host sessions shall [2] remain in a connected state unless broken by explicit direction of the user, broken because a workstation-based inactivity timeout period has been exceeded and the user has been logged off the workstation, or because host constraints have been exceeded, even when the user re-directs attention of the workstation to other sessions. All WIS Workstations shall [3] permit connected host equipment to "time-out" inactive host sessions if host constraints are exceeded; the workstation will not attempt to maintain active sessions by sending null packets, dummy data, or other techniques to maintain communications links. Previously initiated data transfers shall [4] continue until completion when the user re-directs attention to another session.

3.1.4.1.2. LAN based Host Access Interconnections (GRAY)

Several WIS LAN interconnection schemes are required to be supported by the WIS Workstations as a consequence of the evolution of the overall WIS architecture and design. These paths include:

a. An access path using the X.25 based LAN Interface hardware (3.1.7.1.3.3) in conjunction with the LAN IU Interface software (3.1.7.1.4.1). This path will be used by Workstations connected to existing Block A LAN IU equipment.

b. An access path using the IEEE 802.3 based LAN Interface hardware (3.1.7.1.3.4) in conjunction with the TCP/IP Interface software (3.1.7.1.4.2). This path will be used to directly connect WIS Workstations to IEEE 802.3-compatible cable media (both broad

band and baseband) as the WIS LAN architecture evolves towards an IEEE 802.3 LAN architecture.

c. An access path using the X.25 based Interface hardware (3.1.7.1.3.3) and the TCP/IP Interface software (3.1.7.1.4.2). This path may be used by remote WIS Workstations that connect to WIS LANs via direct connections to the Defense Data Network (DDN).

In addition, as the Government Open Systems Interconnection Profile (GOSIP) protocol suite becomes finalized and mature, the WIS architecture will be required to support the GOSIP protocols as the medium to long-term communications architecture, using the IEEE 802.3 LAN Interface as the local access method, and the X.25 Interface hardware for remote WIS Workstation accesses.

All LAN-based host access capabilities described in 3.1.4.1 shall [1] support an upgrade path such that the host access capabilities described herein can use these LAN-based communications paths as the path architectures develop and mature.

3.1.4.1.3. WWMCCS Host Access Services

The WIS Workstation Segment is required to support terminal emulation and file transfer capabilities in order to provide the user access to the current WWMCCS ADP host equipment, software, and data. All emulation and file transfer capabilities described in the following sub-paragraphs shall [1] execute correctly under the native environment supplied and controlled by the multi-tasking operating system described in 3.1.4.2. All emulation and file transfer capabilities shall [2] work correctly on all WIS Workstation systems (Basic and Target). Concurrent access to both direct-connect and LAN-connect based emulation and file transfer capabilities as described in the following sub-paragraphs shall [3] be permitted on all WIS Workstation configurations.

3.1.4.1.3.1. Direct Connect Services

3.1.4.1.3.1.1. Direct Connect Emulation Services

All WIS Workstations (Basic and Target) shall [1] execute correctly a workstation-based system that provides the capability to correctly emulate Honeywell Visual Information Presentation (VIP) 7705W terminal protocols over a direct-connect communication path to the existing WWMCCS host equipment (see 3.1.7.1). Correct direct-connect VIP emulation support shall [2] be in accordance with Honeywell publication AL-29-Rev. 2, "Honeywell Data Communication VIP 7700/7705W Manual.

The Government will ensure that existing Government-owned VIP terminal emulation and graphic software functionality is provided on all WIS Workstation configurations for use over the direct-connect communications path. This functionality includes that provided by the USEUCOM Enhanced Terminal Capability (ETC) VIP terminal emulator and the GIPSYmate Graphics Information Presentation System (GIPSY)-compatible graphics terminal emulation software package.

3.1.4.1.3.1.2. Direct Connect File Transfer Services

All WIS Workstations (Basic and Target) shall [1] execute correctly a workstation-based system that provides the capability to transfer ASCII text and "binary" (see Glossary) files between the WIS

Workstation to the WWMCCS host using the Kermit protocol via the direct connect communications path. This file transfer system shall [2] be usable by workstation-based application programs. The Kermit protocol software shall [3] support the features and options described in Appendix VII.

3.1.4.1.3.2. LAN Connect Services (GRAY)

3.1.4.1.3.2.1. LAN Connect Emulation Services

All WIS Workstations (Basic and Target) shall [1] execute correctly a workstation-based system that provides the capability to correctly emulate Honeywell Visual Information Presentation (VIP) 7705W terminal protocols to support LAN-connect communication with the existing WWMCCS host equipment. Correct LAN-connect VIP emulation support shall [2] be in accordance with Honeywell publication AL29-Rev. 2, "Honeywell Data Communication VIP 7700/7705W Manual. The LAN-based VIP emulation capabilities shall [3] use the TELNET protocol (MIL-STD-1782) in the manner described in WIS-ICD-012, **Interface Control Document for WIS Workstation to WWMCCS Application Interface (TELNET Extension),** as the basic transport mechanism for VIP packet traffic across the WIS LAN.

The LAN-connect VIP emulation system shall [4] be capable of using both the X.25 based LAN interface (3.1.7.1.3.3) in conjunction with the LAN IU Interface software (3.1.7.1.4.1), and the IEEE 802.3 LAN Interface (3.1.7.1.3.4) in conjunction with the TCP/IP based LAN Interface software (3.1.7.1.4.2) as the interface to the LAN cable plant. Use of the TCP/IP based LAN Interface software in conjunction with the X.25 based LAN Interface shall [5] be supported for use by remote workstations accessing a WIS LAN via the Defense Data Network (DDN).

The Government will ensure that existing Government-owned VIP terminal emulation and graphic software functionality is provided on all WIS Workstation configurations for use over all LAN-connect communications paths. This functionality includes that provided by the USEUCOM Enhanced Terminal Capability (ETC) VIP terminal emulator and the GIPSYmate Graphics Information Presentation System (GIPSY)-compatible graphics terminal emulation software package.

3.1.4.1.3.2.2. LAN Connect File Transfer Services

All WIS Workstations (Basic and Target) shall [1] execute correctly a workstation-based system that provides a capability to transfer ASCII text and "binary" (see Glossary) files between the WIS Workstation to the WWMCCS host using the Kermit protocol via all LAN-connect communications paths as described in 3.1.4.1.2.. This file transfer system shall [2] be usable by workstation-based application programs. The Kermit protocol software shall [3] support the features and options described in Appendix VII.

3.1.4.1.4. Access to WIS Workstations as Hosts (GRAY)

All WIS Workstations (Basic and Target) shall [1] support the access of the workstation by other WIS Workstations, in conjunction with the multi-user provisions of 3.1.4.2.1, **Multi-Tasking Operating Systems.** All WIS Workstations shall [2] be capable of initiating a login on other WIS Workstation equipment regardless of the LAN interface supported by the client workstation. WIS Workstations acting as servers shall [3], as a minimum, be relegated to use the IEEE 802.3 LAN Interface (3.1.7.1.3.4) and the TCP/IP Interface software (3.1.7.1.4.2) connection to the WIS LAN cable distribution system.

3.1.4.1.5. Automated Message Handler (AMH) Host Access Services

The Automated Message Handling System (AMHS) will be accessed from the WIS Workstations using the facilities of the various WIS LAN connection paths and other capabilities described herein and in 3.1.7, **Interfaces**, as well as the AMH-specific workstation facilities developed by the Government. The Government will ensure that all AMH host access services software executes correctly with the equipment and software procured in accordance with the requirements described within this Specification.

3.1.4.1.6. WIS Host Access Services

Other WIS and WIS-connected host equipment (JMPE hosts, Site/Command-Unique hosts) will be accessed from the WIS Workstations using the facilities of the various WIS LAN communications paths and other capabilities described herein and in 3.1.7, **Interfaces**. The Government will ensure that all other host access services execute correctly on equipment and software procured in accordance with the requirements contained in this Specification.

3.1.4.1.7. Local and Remote WIS/WWMCCS Host Access (GRAY)

The WIS Workstation will have the capability to connect with local WIS processors via the local WIS LAN. The WIS LAN and associated WIS gateways to the Defense Data Network (DDN) will support access to remote WIS and WWMCCS host resources. Remote WWMCCS processors may also be accessed using the WWMCCS Interconnection Network (WIN) through the local WWMCCS ADP host. The WIS Workstation shall [1] support capabilities to create, modify, and delete a list of host identification data (i.e, a host address table) so as to maintain a user-unique set of local and remote host addresses for use when accessing host resources through the WIS LAN and associated gateways. WIN address table maintenance for WIN connections is performed by the WWMCCS host support personnel, with the result that WIN address tables are not available for modification by the WIS Workstation user. All WIS LAN address tables maintained on the WIS Workstation shall [2] be accessible from standalone, direct-connect, and LAN-connect modes.

3.1.4.2. System and Applications Development Support Services

All WIS Workstation configurations (Basic and Target) need to support a variety of system software that provides a standardized environment for development of WIS applications that execute on the WIS Workstations. These components include:

a. A multi-tasking operating system to provide basic system management services,

b. Various programming language support systems including an Ada compilation system for application and system programming support,

c. Various support packages to provide standardized access to operating system, graphics, window management, and database services provided by the associated software components, and

d. Sub-environments required to support execution of existing Block A software.

This paragraph describes the requirements for each of the above components.

3.1.4.2.1. Multi-Tasking Operating System Services

A multi-tasking operating system is required as part of the fundamental configuration of both the Basic and Target WIS Workstation systems. The following sub-paragraphs describe the requirements that must be met by all WIS Workstation multi-tasking operating systems.

3.1.4.2.1.1. System Initialization

All WIS Workstation multi-tasking operating systems shall [1] provide a capability to initialize and setup the WIS Workstation computer equipment. The multi-tasking operating systems shall [2] provide the capability to perform integrity checks on the file sub-system and security sub-system, as a minimum, during startup and initialization processing, if the appropriate checks are not performed as part of the shutdown processing (see 3.1.4.2.1.2). The multi-tasking operating systems shall [3] provide the capability to enable and disable file system integrity checking during startup, if checking is performed as part of the startup procedure. The WIS Workstation multi-tasking operating systems shall [4] provide a means to force the WIS Workstation to enter the startup state from a "hung" state, or other abnormal state at the user's discretion.

3.1.4.2.1.2. System Shutdown

The WIS Workstation multi-tasking operating systems shall [1] provide the capability to shutdown all devices and software in an orderly fashion. Checks on the integrity of the operating system state shall [2] be made and appropriate actions to ensure the integrity of the operating system taken, during shutdown, if (or in addition to) such checks are not made during system initialization (see 3.1.4.2.1.1). The operating systems shall [3] be capable of recovering to a consistent state from abnormal shutdown situations such as sudden loss of power.

The multi-tasking operating systems shall [4] provide a means by which appropriate LAN connection support software can be activated to close any open LAN connection paths during shutdown processing. The multi-tasking operating systems shall [5] provide a means by which user and/or site designated processing can be executed as part of the shutdown process.

3.1.4.2.1.3. Multiple Tasks

The WIS Workstation multi-tasking operating systems shall [1] support the concurrent execution of multiple tasks, through time-slicing, or other means of multiplexing WIS Workstation processor resources. The number of tasks that can be supported per user (see 3.1.4.2.1.4) by the multi-tasking operating systems shall [2] meet or exceed ten (10). The operating systems shall [3] provide the capability to initiate multiple tasks. The multi-tasking operating systems shall [4] make available the status (e.g., active, waiting, aborted, etc.) of all tasks on the WIS Workstation system at any time it is requested, and from any session currently active.

The operating systems shall [5] support the concept of parent/child tasks. Tasks (parent) shall [6] be able to spawn new tasks (child tasks), assess the status of child tasks, abort child tasks, and communicate with child tasks.

The multi-tasking operating systems shall [7] provide, as a minimum, the following mechanisms by which cooperating (parent/child or sibling) tasks may communicate information:

a. messages,
b. shared memory,
c. semaphores.

The multi-tasking operating systems shall [8] provide the capability to re-direct the keyboard input to any task. Any task shall [9] be capable of directing output to, and requesting input from any device.

The multi-tasking operating systems shall [10] provide the capability to adjust the priority and other scheduling parameters for each task. This capability shall [11] be accessible by the workstation user operating from the WIS Workstation keyboard.

The task management component of the multi-tasking operating system shall [12] use the process isolation, multi-tasking, and memory management support features of the Basic and Target WIS Workstation processor hardware to aid in execution of multiple task management and protection function.

3.1.4.2.1.4. Multiple Users

All WIS Workstation multi-tasking operating systems shall [1] allow additional users to execute on the WIS Workstation equipment. The multi-tasking operating systems shall [2] support a minimum of five (5) concurrent user sessions in addition to the workstation "owner" session. "Non-local" users shall [3] be capable of logging into the WIS Workstation via the LAN, as the LAN architecture matures to support non-local user access to WIS Workstations. Client workstations shall [4] be able to initiate user sessions when connected to the WIS LAN using any of the LAN connection architectures described elsewhere in this Specification, when the LAN architecture has evolved to support workstation logins. Server workstations shall [5], as a minimum capability, be relegated to workstations connected to the WIS LAN using the IEEE 802.3 LAN Interface hardware in conjunction with the TCP/IP Interface software.

No additional terminal interface requirements to support locally attached terminals are to be implied by these requirements.

3.1.4.2.1.5. Virtual Memory

All WIS Workstation multi-tasking operating systems shall [1] provide virtual memory management services where the workstation system can use auxiliary storage space (e.g., disk space, RAM disks, etc.) to provide more application memory space than is physically present in the Basic and Target WIS Workstation hardware system. The virtual memory management subsystems shall [2] provide protection against corruption of a task's memory region by other tasks that are executing concurrently with the given task. Hardware memory partitioning, protection, and virtual memory management provided as part of the processor architecture shall [3] be used by the multi-tasking operating systems to support virtual memory management. Each task shall [4] be presented a virtual address space that meets or exceeds the physical addressing capabilities of the WIS Workstation system.

3.1.4.2.1.6. Multi-Tasking Device Interfaces

The WIS Workstation multi-tasking operating systems shall [1] provide a set of device interfaces and drivers that can be used by any application to access standard WIS Workstation peripherals (e.g., disks, screen display, graphics resources, keyboard and other input devices, backup units, etc.). The multi-tasking operating systems shall [2] mediate access to devices to allow multiple tasks and users to use the same device. Tasks (and users) shall [3] be able to assign certain devices such as printers and disk drives for "own" use while the task is active. Upon task termination or user logout, the operating systems shall [4] reclaim the assigned device and make it available to other tasks and users.

Device drivers shall [5] make use of the process isolation support features of the WIS Workstation processor to provide protection of driver data and instruction spaces from corruption by application tasks.

All multi-task device drivers described herein, other than disk system drivers, shall [6] be capable of mediating the concurrent accesses to a shared device generated by a minimum of ten (10) tasks. The disk system drivers shall [7] be capable of mediating the concurrent disk accesses arising from the maximum number of tasks permitted by the operating system, including all possible user tasks.

3.1.4.2.1.7. Multi-Tasking File System

The WIS Workstation multi-tasking operating systems shall [1] provide file systems that support the capability to define and manage data and program files. The file systems shall [2] support a minimum of two types of objects: files, and file directories. The file systems shall [3] support a hierarchical, tree-structured system through the use of nested file directories. The file systems shall [4] provide a minimum of five (5) levels of file directory nesting, subject to physical storage limitations of the parent volume. Utilities shall [5] be provided that diagram or otherwise indicate the current file system structure to the user on the display screen, and on an attached printer.

A file system interface shall [6] be provided as part of the general operating systems interface (3.1.4.2.3.1) to allow application programs to manipulate the file systems (e.g., add files, delete files, add directories, delete directories, etc.) as well as access and modify the contents of files.

The operating systems' file system shall [7] provide protection mechanisms to coordinate and synchronize access to files by multiple tasks and multiple users on the WIS Workstation. Tasks and/or concurrently logged in users shall [8] be able to share any file system object depending on the type of concurrency control set for the file.

The file systems shall [9] support, as a minimum, the following set of concurrency controls:

a. 1 Reader OR 1 Writer,
b. Simultaneous Multiple Readers OR 1 Writer, and
c. Simultaneous Multiple Readers AND 1 Writer.

The file systems shall [10] provide the capability to assign and modify user/system access rights to any and all file system objects. The capability to ascertain status of access rights for a given set of file objects shall [11] be provided. Rights shall [12] be assignable using references to specific users, groups of users, or by reference to a special group of users that is the set of all users defined on the workstation

(i.e., the "world"). The set of rights that can be managed shall [13] include, as a minimum:

a. No rights,
b. Read rights,
c. Write rights,
d. Execution rights,
e. Creation rights,
f. Deletion rights,
g. Protection rights, and
h. Directory list rights.

Process isolation, state separation, and other process protection features of the WIS Workstation processor shall [14] be used by the file systems' component to ensure that file system instructions and data are protected from corruption by application tasks.

The file systems shall [15] provide the capability to check the integrity of file system objects. The file systems shall [16] also provide recovery mechanisms by which damaged file objects may be recovered (wholly, or partially).

The file systems shall [17] provide backup and restore mechanisms. These mechanisms shall [18] operate with the included disk systems (floppy and hard disks), as well as any special backup hardware systems provided to meet the requirements contained in 3.3.5.4.

3.1.4.2.1.8. Network File System (GRAY)

All WIS Workstation multi-tasking operating systems shall [1] provide a capability to access non-local file systems physically attached to other computing equipment as if the file system were resident on the local workstation storage system (i.e, a "network" or "remote" file system client capability). All functionality exhibited by the local file system software as described in 3.1.4.2.1.7 shall [2] be provided for non-local data and program file accesses and requests.

All WIS Workstation multi-tasking operating systems shall [3] provide the capability to respond to non-local data and program file system accesses and management requests from other hosts on the WIS LAN (i.e., a "network" or "remote" file system server capability).

Client access requests to remote file systems shall [4] be capable of execution by workstations that are connected to the WIS LAN via any of the WIS LAN architectures described elsewhere within this Specification. Server file systems shall [5], as a minimum capability, be relegated to WIS Workstations connected to the WIS LAN via the IEEE 802.3 hardware interface in conjunction with the TCP/IP Interface software.

3.1.4.2.1.9. Supported Devices

All WIS Workstation multi-tasking operating systems shall [1] support all WIS Workstation printers. Background spooling capabilities shall [2] be provided to allow printing to occur in the background while other tasks are concurrently executing.

3.1.4.2.1.10. User Command Language

All WIS Workstation multi-tasking operating systems shall [1] be capable of receiving direct commands from the user and initiating operating system actions based on interpretation of those commands via a command language facility. All facilities of the operating systems shall [2] be made available from within the command language. Facilities to initiate applications and tasks, and pass data between tasks shall [3] be supported.

The operating systems shall [4] be capable of executing pre-written command scripts that contain the command constructs available via direct entry, and other commands normally used within command language programs. The additional types of commands that can be programmed into command scripts shall [5] include: decision constructs (e.g., if-then-else, multi-way branching, etc.), looping constructs (e.g., do-while loops, do-until loops, do forever loops, etc.), branching constructs (e.g., go to, exit, exit if, etc.), assignment constructs (including numeric and string calculation capabilities, and associated variable support capabilities), and subroutine call/return capabilities. Looping shall [6] be controlled, as a minimum, using iteration, by examination of selected file system objects (e.g., "do for all files in this directory"), and by variable values calculated during script execution. Looping and decision constructs shall [7] be capable of executing multiple operating system and script commands during any iteration of the loop, or as the effect of taking a specific branch within a decision construct. It is permissible to use the decision constructs within the command language to "simulate" looping constructs.

Command language scripts shall [8] support a command line parameter passing scheme by which data values may be passed via the command line invoking the script to control the processing performed by the script. Command line parameter values shall [9] be retrievable by applications programs, using appropriate operating system interface routines.

3.1.4.2.1.11. Window Manager

All WIS Workstation multi-tasking operating systems shall [1] provide a user-visible window manager component. This window manager shall [2] be capable of managing a minimum of ten (10) session-level windows for each workstation user. The window manager shall [3] provide the capability to exercise and use all the features of any attached WIS Workstation display systems (e.g., colors, resolutions, text characteristics, etc.). The window manager component shall [4] be capable of creating, opening, moving, sizing, adding, deleting, and closing session-level windows (see Glossary for definition of "session-level window"). All windows (session-level windows, and sub-windows) shall [5] be capable of overlapping. Within each session-level window, the capability to initiate, terminate, and otherwise control application programs running within the window environment, upon command, shall [6] be provided. The window manager shall [7] provide the capability of scrolling the window to cover the virtual display space assumed by the application running in the window. "Cut and paste" operations between arbitrary windows shall [8] be provided, subject to the ability of the application executing in the window to support "cut-and-paste" operations, and subject to security policies implemented to provide secure windowing environments (see Appendix V). The window manager shall [9] be based on the foundation provided by the windowing support package described in 3.1.4.2.3.2.

3.1.4.2.1.12. Visual User Interface

All WIS Workstation multi-tasking operating systems shall [1] support an interface shell by which the workstation user can initiate applications, access data files, and perform operating system

actions using such standard user interface techniques as menu selection, pointing device selection, and or single keystroke (i.e., macro expansion) techniques, without resorting to the underlying command language of the operating system. The interface shell shall [2] be capable of being customized to tailor the shell to individual preferences. Customization could include inserting/deleting selected applications, shell scripts and documents into/from appropriate menu structures to allow ease of access, defining macro expansions and tying expansions to keys, as well as other tailoring actions which are tied to the specific methods employed by the shell. Interface shell customizations shall [3] be saved for use in succeeding sessions. All tools required for customization shall [4] be considered part of the shell package and provided as part of the delivered software.

The interface shell shall [5] provide the capability of passing operating system command language directives to the underlying multi-tasking operating system for execution, and returning to normal operation upon completion of the directive.

The interface shell shall [6] work in conjunction with the windowing software supplied to meet the requirements of 3.1.4.2.3.2 (Window Management) and 3.1.4.2.1.10 (Window Manager). The user interface requirements described in 3.1.4.3.1 (User Services Support) shall [7] be required of the interface shell, where appropriate.

3.1.4.2.1.13. System Administration

All WIS Workstation multi-tasking operating systems shall [1] provide a set of tools that aid in the administration of the WIS Workstation multi-tasking operating system. Tools shall [2] be provided that support the definition and maintenance of user access profiles, the creation and maintenance of system directories and files, the performance of backups and recoveries, the installation of new software and device drivers, and other system administration duties. The tools shall [3] provide a novice user's interface that guides the user in making decisions during administration sessions. Expert access to these tools shall [4] be provided to allow quick, expert access to administration tools and capabilities. All system administration tools shall [5] be protected against access by non-cleared personnel. Security-related system administration tools shall [6] be provided that adhere to the requirements of Appendix V.

3.1.4.2.1.14. Security Requirements

3.1.4.2.1.14.1. User Logins

All WIS Workstation multi-tasking operating systems shall [1] include a user login/logoff control, validation, and auditing capability which traces use of the workstation in all modes (standalone, direct-connect, and LAN-connect). Information to be included in the user login audit trail shall [2] consist of the following data:

a. User ID,
b. Event Type (login, logoff, login failure), and
c. Date and time of event.

Workstation access shall [3] be denied to any user attempting to login to a workstation who does not have a valid identity resident within the workstation user audit system. Only a limited number of login attempts shall [4] be permitted as part of the login processing function. The maximum number of login attempts shall [5] be settable by the system administrator. Each failed login attempt shall [6] generate a login failure event and cause the event to be logged in the audit file. Failure to successfully

login after this limit is exhausted shall [7] cause an audit record to be generated, and the login process to be reset to an initial state. A lockout strategy shall [8] be provided, settable by the system administrator, that locks out the workstation for a period of time after the permissible number of login attempts have been exhausted.

The multi-tasking operating systems shall [9] permit a user to login to the workstation even if the previous user had not logged off the system. The multi-tasking operating systems shall [10] automatically log off the previous user prior to starting the login process for the new user. An audit record shall [11] be generated indicating the need for the automatic logoff on the part of the previous user.

During the user login process, all WIS Workstation multi-tasking operating systems shall [12] provide the capability to display site-specific information, from a system "message" file, on the user's terminal screen prior to allowing the user access to the system after the validation process is completed.

The multi-tasking operating systems shall [13] provide a timeout mechanism whereby user sessions will be automatically terminated upon the expiration of a timed period of inactivity. A period of inactivity is defined to be a period of time where the system waits for command instructions from the user, and receives none. The period of time allowed for inactivity before automatic logoff shall [14] be settable by the system administrator.

Under all circumstances, when a user logs off the machine, all associated tasks shall [15] be terminated along with the main user session.

The login facility shall [16] provide, at a minimum, a password protection scheme as part of the user validation process. Passwords shall [17] be changeable by the password owner, and the system administrator. The login facility shall [18] provide a password expiration capability where the system keeps track of age of the password, and requires the user, after a settable period of time, to change the password. All password facilities, including the use of the password facility shall [19] be capable of being disabled by the system administrator, or, alternatively, the password system shall [20] support the use of null or blank passwords that do not age.

Access to audit data shall [21] be limited to only appropriately cleared users. Audit tools shall [22] be provided as part of the system administration tool set to access, display, and manage audit data resident on the workstation. The user audit data tool shall [23] provide a capability to download user audit data onto the system administrator's workstation.

3.1.4.2.1.14.2. Declassification Utilities

All WIS Workstation multi-tasking operating system designs shall [1] include utilities that perform the following functions:

a. A secure disk file erase function to ensure that all file information (deleted file records, blocks, etc.) is totally removed from the WIS Workstation disk system upon file deletion, file truncation, or any other action that returns file records to the operating system for reuse.

b. A secure memory erase function that will ensure that all user-modifiable memory within the system (including paging and swapping space) is cleared of all retained information. This utility shall [2] be invoked during user logoff to ensure that all sensitive information related to the user is removed from system physical memory and paging space when a user is finished with the machine.

All WIS Workstation multi-tasking operating systems shall [3] contain programs and procedures for securely erasing all disk media and other permanent memory devices to effect declassification of the workstation hardware.

All declassification utilities shall [4] meet or exceed the requirements contained in JCS Publication 6-03.7, **Security Policy for the WWMCCS Intercomputer Network.** All utilities will be examined and certified by the Government as to the degree of trust that can be placed in the software.

3.1.4.2.1.14.3. System High Certification Requirements

All WIS Workstation multi-tasking operating systems shall [1] meet the requirements contained in 50.1, **Security Requirements for System High Workstations.** All program development facilities shall [2] operate within the security environment without compromising the overall security certification of the system.

3.1.4.2.1.14.4. Limited Multi-Level Secure Certification Requirements (GRAY)

The multi-tasking operating systems supplied with all WIS Workstation configurations shall [1] meet the requirements contained in 50.2, **Security Requirements for Controlled Mode Workstations,** and the requirements for B2 evaluation criteria as defined in DoD 5200.28-STD. All program development facilities shall [2] operate within the security environment without compromising the overall security certification of the system.

3.1.4.2.1.15. MS-DOS Requirements

All WIS Workstation multi-tasking operating systems shall [1] provide the capability to execute correctly programs developed for the MS-DOS operating system (or equivalent) as a sub-environment under control of the multi-tasking operating system. The MS-DOS environment shall [2] support the execution of MS-DOS native executable load modules or program files. The version of MS-DOS to be supported by this environment shall [3] be version 3.3.

The MS-DOS sub-environment provided by the multi-tasking operating systems shall [4] support the correct execution of the following WIS Early Products Workstation software, as a minimum:

a. DataEase,
b. Visiword, and
c. Intecalc.

Appendix III provides more information about the entire set of Early Products software, including the required software listed above.

All WIS Workstation multi-tasking operating systems shall [5] provide and manage access to all hardware resources resident on the workstation on the part of the MS-DOS applications. Access to all resources shall [6] be shared between the MS-DOS application task(s) and native multi-tasking operating system tasks.

All WIS Workstation multi-tasking operating systems shall [7] provide a means to perform file system operations, including but not limited to generating directory listings, copying files, deleting files, and examining files, on media containing MS-DOS file systems and files. All WIS Workstation multi-

tasking operating systems shall [8] provide a means to transfer (copy) files between the MS-DOS media and the native multi-tasking operating system file subsystem. All WIS Workstation multi-tasking operating systems shall [9] provide the capability that allows MS-DOS partitions and volumes to concurrently reside on high-capacity disk subsystem media along with native operating system volumes and partitions.

3.1.4.2.2. Language Translation Services

Various compilers and assemblers are required for use with both the Basic and Target WIS Workstations to support the development of new applications for the workstations, and the transfer of existing applications to the new platforms. The following sub-paragraphs describe and define the requirements for the WIS Workstation language translation tools.

All workstation language translators, Ada, C, and assembler, shall [1] provide the capability to build "mixed-mode" executable programs, where components of a program are derived from any of the translators.

3.1.4.2.2.1. Ada Language Support

An Ada language compiler and development support system is required for development of code usable on both the Basic and Target WIS Workstation to support the development of application programs for the WIS Workstation systems. The following sub-paragraphs describe the features and characteristics required of the Ada-based development support system.

3.1.4.2.2.1.1. General

All WIS Workstation Ada compilers shall [1] produce native machine code compatible with the subject WIS Workstation processors and operating systems. All WIS Workstation Ada compilers shall [2] be validated, and remain validated, to ensure strict compliance with ANSI/MIL-STD-1815, **Ada Language Definition.** Validation of all WIS Workstation Ada compilers shall [3] be in accordance with the current practices and procedures of the Ada Joint Program Office (AJPO).

3.1.4.2.2.1.2. Components

The Ada language compilation system shall [1], at a minimum, consist of the following components:

a. The Ada compiler,
b. A library management facility to support Ada separate compilation requirements,
c. A linker/loader utility,
d. A source code debugger, and
e. A source code editor.

All components shall [2] execute correctly within the native operating system environment provide by the Target WIS Workstation multi-tasking operating system, as a minimum.

3.1.4.2.2.1.2.1. Source Code Editor

The WIS Workstation Ada compilation systems shall [1] contain a source code editor to be used in creating and editing Ada source code files. The editor shall [2] create text files that can be read by the Ada compilation system tools. The editor shall [3] provide the text manipulation and display functions as specified in 3.1.4.3.2.3 for the WIS Workstation Word Processing Facility, with the exception of 3.1.4.3.3.3.2, **Text Formatting** .

3.1.4.2.2.1.2.2. Compiler

The Ada compiler shall [1] generate code that can access the entire virtual memory address space provided by the multi-tasking operating systems on both the Basic and Target WIS Workstations. The Ada compiler shall [2] generate code that makes use of the hardware numerical processing capabilities contained within the WIS Workstation processor hardware. The object code produced by the Ada compilers shall [3] be compatible with all other language translators in use on the WIS Workstation. An Ada INTERFACE pragma shall [4] be provided for all other languages supplied as part of the WIS Workstation application development facilities to allow mixing of object code derived from other language translators.

3.1.4.2.2.1.2.3. Linker/Loader

A linker/loader utility shall [1] be supplied as part of the Ada compilation system to combine object code from various source code compilations and pre-compiled libraries to form executable program image files. The program image files created by the linker/loader shall [2] execute within the native environment supplied by multi-tasking operating system. The linker/loader shall [3] permit the inclusion of object code derived from non-Ada source code files (i.e., C, assembler, etc.) as part of the resulting executable module. The linker/loader shall [4] permit the inclusion of object code from other separate Ada libraries, as well as the current program library. The linker/loader shall [5] permit the assignment of variable blocks, program code blocks, and other entities defined within the source code to specific areas within the system memory architecture.

3.1.4.2.2.1.2.4. Debugger

The source code debugger shall [1] provide, as a minimum, the following set of capabilities when debugging executable program files:

a. The debugger shall [2] have the capability to set breakpoints within the executable program image where control is returned to the debugger. The debugger shall [3] provide a related capability to insert tracepoints where the debugger prints message indicating that a tracepoint has been encountered. Breakpoints and tracepoints shall [4] be inserted at points within the executable image by references to the Ada source code that was used to create the executable image. Optional processing (evaluation of expressions, printing of variables, etc.) shall [5] be permitted as part of the breakpoint and tracepoint processing. The debugger shall [6] allow the definition of conditions on breakpoint and tracepoint processing so that breakpoints and tracepoints are processed only under certain conditions. Breakpoints and tracepoints shall [7] be capable of insertion at entry and exit from subprogram units (subroutines, functions, etc.).

b. The debugger shall [8] provide the capability to examine and change the states and values of variables, arrays, pointers, and other data structures within the program image. Variable examination and assignments shall [9] be permitted as part of breakpoint processing as well as prior to commencement of program execution.

c. The debugger shall [10] provide access to the program source code.

d. The debugger shall [11] provide the capability to manually step through program execution, automatically returning control back to the debugger upon completion of the program step. Stepping shall [12] be in user-defined increments. Stepping shall [13] be referenced Ada source code statements, i.e., manual stepping refers to stepping through Ada source code statements, not machine code instructions.

e. The debugger shall [14] provide a call-trace facility that traces the subprogram calling hierarchy at any given point in program execution where execution has been interrupted. Errors arising from run-time library or operating system violations shall [15] be trapped and a call-trace executed prior to returning control to the debugger.

f. The debugger shall [16] trap all error conditions, signals, and interrupts signalled by the operating environment that would normally cause the program to abort. The debugger shall [17] retain control after the signal is generated and return to the command state where examination of the problem can begin.

3.1.4.2.2.1.2.5. Library Manager

A library manager shall [1] be supplied to support Ada requirements for separate compilation and compile-time error checking. The library manager shall [2] permit the sharing of units in a library with other libraries. The library manager shall [3] permit the inclusion of different unit bodies (in different libraries) for a single specification. This capability would allow the creation of libraries based on differing processing requirements and algorithms to be built that support the same interface, supporting the Ada concepts of packaging and reuseability.

3.1.4.2.2.1.3. Performance

Standard compiler performance test software has been defined and provided (see Appendix IV). Ada-based workstation performance software has also been obtained and executed on a standard testbed in support of the requirements contained 3.2.13. All the Ada-based test software obtained to support this Specifications shall [1] be compiled at a rate no less than one hundred (100) Ada source statements per minute on all WIS Workstations.

3.1.4.2.2.2. C Language Support

A C language compiler is required for both the Basic and Target WIS Workstation to support the transfer of existing programs to the WIS Workstation system. Object code produced by the C compiler shall [1] be compatible with the code produced by the Ada compiler (3.1.4.2.2.1). All application development support packages contained in 3.1.4.2.3 shall [2] be usable within C-based programs. The C compiler shall [3] support the ANSI standard C language.

3.1.4.2.2.3. Assembly Language Support

An assembly language translator is required for both the Basic and Target WIS Workstation to support the transfer of existing programs to the WIS Workstation system. Object code produced by the assembler shall [1] be compatible with the code produced by the Ada compiler (3.1.4.2.2.1), and C compiler (3.1.4.2.2.2). All application development support packages contained in 3.1.4.2.3 shall [2] be usable within assembler-based programs.

3.1.4.2.2.4. Special Purpose Language Support

Special-purpose maintenance software (e.g., macro maintenance utilities, menu maintenance languages, etc.) associated with specific software packages shall [1] be considered as part of the related software package and provided as part of the package to support WIS community customization and tailoring.

3.1.4.2.3. Application Development Support Services

All WIS Workstation architectures are required to support application development support packages, described in the following sub-paragraphs, to support the development of application programs for use on WIS Workstation systems. All libraries provided to meet the requirements contained in this paragraph shall [1] be usable, and operate correctly, with object code generated by all of the specified language compilers (Ada, C, and assembler). All libraries shall [2] interoperate correctly with all WIS Workstation multi-tasking operating systems. All libraries shall [3] implement the full set of functionality as defined in the appropriate standards for each package.

3.1.4.2.3.1. Operating System Primitives

All WIS Workstation multi-tasking operating systems shall [1] support and execute correctly a library of subroutines and procedures that allow access to operating system primitives by application programs.

The operating system interface library supplied as part of the WIS Workstation multi-tasking operating system shall [2] conform to the Posix Standard, as defined in FIPS Publication 151.

All operating system libraries shall [3] be compatible and usable with object code produced by all WIS Workstation language compiler systems, including, specifically, the Ada compilation system. Ada package specifications shall [4] be provided for the operating system interface package to support development of Ada-based application programs.

3.1.4.2.3.2. Window Management Primitives

All WIS Workstations shall [1] support and execute correctly a windowing library package that contains, as a minimum, the functionality of X-Windows version 10.4, or equivalent. The WIS Workstation windowing library shall [2] be upwardly compatible with X-Windows version 11, and will be upgraded to support the X-Windows protocol within six (6) months of acceptance of the X-Windows version 11 standard. This window management package shall [3] be compatible and usable with the WIS Workstation Ada compilation system, and shall [4] be compatible and usable with the WIS Workstation multi-tasking operating system and operating system window manager components. Ada package

specifications shall [5] be provided for the window management interface package to support development of Ada-based application programs.

3.1.4.2.3.3. Database Management Primitives

All WIS Workstation database management systems shall [1] provide and correctly execute a library of subroutines and procedures that gives application program access to the data base management system supplied with the WIS Workstation (see 3.1.4.3.5). The library shall [2] support an ANSI/SQL binding definition as defined in FIPS Publication 127 as one possible means of accessing database services from application programs. Ada package specifications shall [3] be provided for the database management interface package to support development of Ada-based application programs.

3.1.4.2.3.4. Graphics Primitives

The WIS Workstations shall [1] support and execute correctly a set of graphics primitives services encapsulated into a set of graphics primitives libraries that meet or exceed the requirements of the Graphics Kernel System (GKS), ANSI X3.124-1985, Level 2C. A GKS Ada language binding package shall [2] be provided as part of the library. The graphics primitive libraries shall [3] contain drivers to drive all graphics input and/or output devices supported by the WIS Workstation hardware, including all graphics-based WIS Workstation printers. All graphics primitives services software shall [4] operate in conjunction with the windowing primitives software package (3.1.4.2.3.2) and the multi-tasking operating system software (3.1.4.2.1), including the window manager component.

3.1.4.2.3.5. Device Support Primitives

All WIS Workstations shall [1] support and execute correctly a device library that provides access to all WIS Workstation peripheral devices to applications programs. Ada package specifications shall [2] be provided for the device support interface package to support development of Ada-based application programs.

3.1.4.2.3.6. DoD Software Protocol Interface Primitives (GRAY)

All WIS Workstations shall [1] support and execute correctly an application library that permits application programs access to the DoD protocol processing supplied to satisfy requirements contained in 3.1.7.1.5.2. As a minimum, application programs shall [2] be able to initiate file transfers using the FTP protocol with a connected WIS host, and send mail via the SMTP protocol. Access to the SMTP-supported mailbox system resident on the WIS Workstation shall [3] be provided as part of this protocol software in order that application programs can process mail.

3.1.4.2.3.7. GOSIP Protocol Interface Primitives (GRAY)

All WIS Workstations shall [1] support and execute correctly an application library that permits application programs to access the protocol processing embodied in the Government Open Systems Interconnection Profile (GOSIP) protocol software supplied to satisfy requirements contained in 3.1.7.1.5.3. Entry to protocol processing at all OSI protocol levels supported by the supplied GOSIP software shall [2] be made available to application programs via this application program library.

3.1.4.3. User Support Services

The WIS Workstation will support a set of user services support software packages including wordprocessors, spreadsheets, database managers, and graphics, to provide personal computer services to the WIS community. The requirements for the individual packages that comprise the user services software suite are described in this paragraph of the WIS Workstation Segment Specification.

3.1.4.3.1. User Support Services Interface Requirements

The following requirements shall [1] apply to all User Interface components of all User Services Software described in 3.1.4.3.

3.1.4.3.1.1. General

All User Services Support software shall [1] possess the following attributes that increase the usability of the software:

a. The command structure within the software shall [2] exhibit a logical consistency and regularity that eases the task of remembering commands and the associated command structures. Commands and command structures shall [3] reflect the underlying functionality and anticipated use of the software.

b. User aids such as menus and "fill-in-the-blank" forms shall [4] be used to the greatest extent possible to ease the burden of interfacing and providing information to the software.

c. All displays shall [5] provide a consistent viewpoint and unity.

d. The employment of keystrokes and other input actions such as mouse clicks or button presses shall [6] be limited to the minimal number required to accomplish the requested task.

e. The software shall [7], to the greatest extent possible, leave the determination of sequences of actions to the user, and not impose its own notions of how tasks are to be accomplished, or in what sequence. The guiding principle is that the software should respond to input requests, and not require the user to respond to it.

f. The software shall [8] provide capabilities, where applicable, that permit rescinding actions, at user discretion, and the restoral of the subject data to a state exhibited by the data prior to the execution of the rescinded action. Such features as UNDO, and DELETE recovery are common examples of the type of functionality to be included in this software.

3.1.4.3.1.2. Menus

Menu systems, when used within the user interface of a specific software package, shall [1] possess the following characteristics:

a. Options on a given menu shall [2] possess a logical unity and be arranged in the same order as a user is likely to execute a sequence of events.

b. If the same option appears on more than one menu (e.g., "Exit"), this option shall [3] appear in the same relative position in these menus.

c. Menu nesting shall [4] be kept to within five (5) levels.

d. Cues shall [5] be provided that indicate which menu in the hierarchy is currently displayed, and where the position in the menu hierarchy is currently set.

e. The text of each menu option shall [6] be self-explanatory and terse.

f. The menu shall [7] visually indicate the user's currently selected option.

g. Menu selection activation shall [8] require no more than one (1) keystroke or pointing device action to activate the desired menu selection.

h. When using a menu cursor as the means of delineating menu item selection (as opposed to entering a choice indicator in response to a prompt), the cursor action keys associated with the WIS Workstation keyboard shall [9] be usable to perform the menu cursor control actions, using the nominal interpretation of the various keys (left, right, up, down, etc.).

i. Menus shall [10] provide mechanisms to allow a return to the previous menu in the hierarchy, and a mechanism by which an escape to an initial menu state may be effected.

j. All menu systems shall [11] be usable with all input devices supplied with the WIS Workstation (keyboards, pointing devices such as mice, track balls, etc.).

k. All menu systems shall [12] provide a means to bypass the menu structures and proceed directly to the desired function or capability.

3.1.4.3.1.3. Help

On-line help shall [1] be provided for all software packages. The following characteristics shall [2] be required of all help systems:

a. Help shall [3] be available at every stage of operation of package. Help requests shall [4] be able to be entered and processed at any stage of specific package processing. The help function shall [5] be "context-sensitive", presenting only that information relevant to the processing being performed.

b. Accessing the help function shall [6] be free of any destructive consequences for current work-in-progress.

c. When leaving the help function, the status of the software shall [7] be restored to that state in the current operation corresponding to when help was originally requested, and the operation of the software resumed as if the help function had not been invoked.

d. Error reporting shall [8] provide English-based explanations as to the likely cause of the error, and possible recommendations for remedial action, if any. Examples of acceptable explanations include messages such as "The disk is full", or "The file requested does not exist." Reporting of arcane error indicators and directing attention to user's reference manuals will not be considered meaningful and will not be satisfactory in meeting this requirement.

3.1.4.3.1.4. Operation Termination

The capability shall [1] be provided to immediately terminate any operation or activity that is currently in progress which does not leave data objects in an unstable, indeterminate state. If termination of any operation has the potential of leaving data objects in an unstable, indeterminate state, the option to rescind the action taken shall [2] be provided. When terminating the operation of the software, the option to save or discard changes made to documents during the session shall [3] be provided. Actions that could affect the existence of documents on the workstation storage subsystem (e.g., deletion, disk reformatting, etc.) shall [4] provide a safeguard mechanism that provides alerts as to the consequences of intended actions with regard to existing document files and allows for rescinding the operation.

3.1.4.3.2. Integrated User Support Services

Software which integrates a subset of the functions described in 3.1.4.3 is required for use with the all WIS Workstations (Basic and Target Workstation configurations). All WIS Workstations shall [1] be capable of executing correctly an Integrated Software Suite whose individual components meet the requirements of the following User Services capabilities described in 3.1.4.3:

a. Word Processing (3.1.4.3.3),
b. Spreadsheet (3.1.4.3.4),
c. Database (3.1.4.3.5), and
d. Basic Graphics (3.1.4.3.6).

An Integrated Software Suite shall [2] be defined as a software environment which consists of functional modules such as word processing, spreadsheets, database management, that have been created to work together as an integrated system. Characteristics that indicate the degree of integration shall [3], as a minimum, include:

a. Consistency of the user interface across different functional modules,
b. Capabilities to pass and incorporate data from one module to the next, and
c. Ease of movement between various modules.

Integration of the required functions can occur through the use of a monolithic software package, or through the use and enforcement of a standardized environment (such as an operating system) that provides the integration function.

3.1.4.3.3. Wordprocessing Support Services

3.1.4.3.3.1. General

The word processing function shall [1] provide the capability to generate, display, review, modify, format and print, load, and store text-based documents using the hardware facilities of the WIS

Workstation configurations. All storage units provided as part of all WIS Workstation configurations shall [2] be supported by the word processing function. All input devices (keyboards and pointing devices) and displays provided as part of all WIS Workstation configurations shall [3] be supported by the word processing function software. All hardcopy devices (i.e., printers) provided as part of the WIS Workstation Segment shall [4] be supported by the word processing function. All inherent capabilities of all WIS Workstation printers shall [5] be accessible from within the Word Processing Support Services software.

3.1.4.3.3.2. Display Functions

3.1.4.3.3.2.1. Alphanumeric Character Set

The text processing system shall [1] be able to generate, process, and display the complete ASCII character set as specified in FIPS Publication 1-2. Control characters shall [2] remain invisible on the screen as a default condition. The word processor shall [3] provide the capability allow the display of ASCII control characters, as an option that can be toggled on or off.

3.1.4.3.3.2.2. Display Configuration

The word processing system shall [1] support a minimum of two (2) full-function edit windows. All editing, formatting, and display capabilities defined within the word processor shall [2] be available in all windows if that window is the currently active editing window. When viewing several windows of data in a windowed word processor screen, the source of the data in each window shall [3] be either from multiple data files, or multiple views from the same data file, or some combination thereof.

3.1.4.3.3.2.3. Paging

The word processing system shall [1] automatically page the display as text is entered into the system from the keyboard or reviewed. At least two lines of text from the previous page shall [2] be displayed in addition to new text from the current page when generating text. The capability to move to an arbitrary display page shall [3] be provided. Page breaks that will result in physical separation of pages when the document is printed shall [4] be indicated to the user during display of the text on the workstation screen. A visual indication of the current (printed) page number shall [5] be provided as part of the position indication display associated with the overall text display.

3.1.4.3.3.2.4. Scrolling

The word processing system shall [1] provide the capability for bidirectional vertical and bidirectional horizontal scrolling under direct user control. Visual indication of file position shall [2] be maintained while scrolling through text files.

3.1.4.3.3.3. Text Processing Functions

3.1.4.3.3.3.1. Text Generation and Text Review

The word processing facility shall [1] provide a set of capabilities for interactive text generation, editing, and review using a "full-screen" editing style (i.e., a "what you see is what you get", or WYSIWYG, methodology). At any point during text generation, editing, and review, the capability shall [2] be provided for users to scroll or page the text to review previously entered material.

3.1.4.3.3.3.2. Text Formatting

The text formatting capabilities shall [1] provide the following set of text formatting actions:

a. Set right and left margins,
b. Set page length and top/bottom margins,
c. Automatic Header/Footer generation,
d. Right, left, and center justification of text,
e. Tab setting and expansion,
f. Automatic pagination and associated page numbering and renumbering,
g. Multi-column formatting,
h. Line spacing (e.g., single-spaced, double-spaced, etc.),
i. Underlining, and
j. Insertion/Deletion of page breaks/page feeds.

For multi-column formatting, the word processor shall [2] support at least four (4) columns.

The word processor shall [3] be capable of including differing fonts, font sizes, and print styles (bold, italic, bold and italic, etc.) within a single document. The font and style of a document shall [4] be alterable for any level of text units (characters, words, sentences, paragraphs, pages, documents). The font and style of all components of a document (main text, headers, footers, footnotes, etc.) shall [5] be independently modifiable.

Headers and footers shall [6] be capable of containing the following types of data, as a minimum:

a. Date and time,
b. Page number, and
c. User-defined text.

Size of headers and footers, in lines of printed text, shall [7] be arbitrarily large within the overall limits set by the page length setting. Justification, tabbing, and other formatting actions with regard to individual header and footer definitions shall [8] be capable of specification independent of the main document. Multiple header and footer definitions shall [9] be supported, with arbitrary placement within the text as to invocation of particular definitions. Even and odd-page variations of headers and footers shall [10] be supported.

A footnoting capability shall [11] be provided. Formatting shall [12] allow for inclusion of footnotes into a page of text. Formatting of text pages shall [13] be cognizant of and make allowances for inclusion of footnote text when formatting pages during printing. Indication of footnote numbering or other footnote indexing scheme shall [14] be included in the main text. The footnote facility shall [15] provide automatic numbering and renumbering of footnotes as footnotes are inserted, removed, and moved within the text.

3.1.4.3.3.3.3. Line Length Designation

The capability shall [1] be provided to designate the display line length in support of whole-word wraparound.

3.1.4.3.3.3.4. Whole Word Wraparound

For entered text that exceeds the set line length limit, words that cannot fit within the boundaries of the user established display right margin shall [1] automatically wrap to the start of the left margin of the succeeding line. This capability shall [2] be overridden upon user request.

3.1.4.3.3.3.5. Delete Text

The word processor shall [1] provide for the deletion of a character, word, line, paragraph, or other areas of designated text. When necessary, the closure function shall [2] be automatically executed as part of the delete function. Automatic re-formatting of the display shall [3] be accomplished as text is deleted. The capability to undo deletion actions shall [4] be provided.

3.1.4.3.3.3.6. Insert Text

The capability shall [1] be provided to insert text at a designated position within the document. The insertion point shall [2] be capable of positioning to any point within the document prior to text insertion. Automatic re-formatting of the display shall [3] be accomplished as text is inserted.

3.1.4.3.3.3.7. Replace Text

The word processor shall [1] provide the capability to replace a designated character or string with a new character string. Automatic re-formatting of the display shall [2] be accomplished as text is replaced.

3.1.4.3.3.3.8. String Search

The word processor shall [1] provide the capability to search for a user-designated string within a text document, as well as in a user-designated group of documents. This capability shall [2] include the ability to find the first occurrence of a string, the last occurrence of a string, and the next occurrence of a string (stepping ability), within certain subsets of text (e.g., a page), within a designated area of the text document, as well as within the entire document.

Searching shall [3] occur in a forward manner through the file, stopping at the end of the document. The search function shall [4] be capable of "wrapping around" to the start of a document when the end is reached, finally stopping at the search start point. The "wraparound" capability shall [5] be a settable option.

The word processor shall [6] provide a "wildcard" search capability where various "metacharacters" and conventions can be used to specify classes of text and placement of text within a larger unit that are to the objectives of the search, as well as literal text itself.

3.1.4.3.3.3.9. Search and Replace

The word processor shall [1] provide the capability to modify strings of text found during a search operation. The word processor shall [2] provide the capability to manually replace each matched string with user-entered replacement text and continuing the search. The manual search-and-replace function shall [3] provide a "skip" capability which will cause the search-and-replace function to proceed to the next

match without modifying the current matched text. The manual search-and-replace function shall [4] provide an entrance into the main editor to support extensive modifications of matched text, and restart the search from the point that it was interrupted, once editing is finished.

The word processor shall [5] provide the capability to perform an automatic replacement of each instance of text found during a search operation with user-designated replacement text (i.e., "global search and replace"). Automatic search and replace operations shall [6] be capable of being started at any point during a manual search and replace operation, as well as at the start of a search operation. Start of the automatic search-and-replace operation shall [7] be capable of initiation from any point in the text.

The search-and-replace operation shall [8] possess both the capability to stop at the end of the document, and the capability to "wrap around" to the start of document, stopping at the start of the search. Use of either capability shall [9] be a settable option. Automatic re-formatting of the display shall [10] be accomplished as text is replaced at each instance, both for manual and automatic search-and-replace operations.

3.1.4.3.3.3.10. Move Text Within Files

The word processor shall [1] provide the capability to move designated groups of text from one position in a file to another position (i.e., "cut and paste"). Movement shall [2] be possible from any location within a document, to any location of the document, resulting in the movement of an arbitrarily large piece of text. The text that is copied shall [3] be deleted from the source position in the document. The capability to paste the excised text at multiple positions within the document shall [4] be supported. Automatic reformatting of the document and display shall [5] be accomplished as text is pasted into the document.

3.1.4.3.3.3.11. Copy Text Within Files

The word processor shall [1] provide the capability to copy designated groups of text from one position in a file to another position (i.e., "copy and paste"). Movement shall [2] be possible from any location within a document, to any location of the document, resulting in the movement of an arbitrarily large piece of text. The text that is copied shall [3] be retained at the source position in the document. The capability to paste the copied text at multiple positions within the document shall [4] be supported. Automatic reformatting of the document and display shall [5] be accomplished as text is pasted into the document.

3.1.4.3.3.3.12. Move Text Between Files

The word processor shall [1] provide the capability to designate text and move said text into another document (i.e., "cut-and-paste"). An arbitrarily large amount of text shall [2] be "movable" into the destination document from the source document. This capability shall [3] delete the designated text from the source document. The system shall [4] permit simultaneous display of the both the document where text is being inserted and the document from which the text will be withdrawn for insertion. The text insertion point within the destination document shall [5] be "settable" to at an arbitrary point within the document. Re-formatting of the document and display shall [6] occur as the text is inserted into the destination file. The capability to paste the excised text into multiple locations within the destination document shall [7] be provided.

3.1.4.3.3.3.13. Copy Text Between Files

The word processor shall [1] provide the capability to designate text and copy said text into another document (i.e., "copy-and-paste"). An arbitrarily large amount of text shall [2] be "copyable" into the destination document from the source document. This capability shall [3] retain the designated text within the source document. The system shall [4] permit simultaneous display of the both the document where text is being inserted and the document from which the text will be withdrawn for insertion. The text insertion point within the destination document shall [5] be "settable" to at an arbitrary point within the document. Re-formatting of the document and display shall [6] occur as the text is inserted into the destination file. The capability to paste the excised text into multiple locations within the destination document shall [7] be provided.

3.1.4.3.3.3.14. Merge Text

The word processor shall [1] provide a capability to merge groups of text files in a specified order to create a new text file.

3.1.4.3.3.3.15. Closure

The word processor shall [1] automatically adjust text, characters, words, and lines so that the resulting text is correctly spaced. The closure function shall [2] extend beyond page boundaries and include the automatic creation and/or deletion of pages, as necessary.

3.1.4.3.3.3.16. Loading Text

The word processor shall [1] provide the ability to import/load files that are in any of the following formats:

a. the internal format supported by the word processor,

b. an ASCII "text" format where the file contains only displayable ASCII text and line control characters such as carriage returns and line feeds,

c. a suitable format used for exportation by the WIS Early Products word processing software package (which may include any of the above formats). See Appendix III for packages used. Note that it is permissible to require that the data file be pre-processed by the Early Products software prior to importation by the word processor.

For ASCII files, the word processor shall [2] provide the option of conversion of those files into internally formatted files. Importation of files, in any of the previously mentioned formats, shall [3] be provided at any designated point within a document, for incorporation of previously existing text data into a newly edited document.

3.1.4.3.3.3.17. Saving Text

At any stage during the composition or review of a document, the word processing facility shall [1] be capable of saving the text thus far contained within the document in a designated workstation file.

The word processor shall [2] overwrite the input file if no file is designated for saving. The automatic overwriting of previously created documents shall [3] be an settable option. The word processor shall [4] support a mode where such default save action will result in a verification request being generated and acted upon prior to execution of the save operation.

The word processor shall [5] possess the capability to perform automatic backups of data files prior to initiation of editing. The backup capability shall [6] be "selectable" feature which can be toggled on or off.

The word processor shall [7] provide the option of saving the file in any one of the following formats:

a. the internal format supported by the word processor,

b. an ASCII "text" format where the file contains only displayable ASCII text and line control characters such as carriage returns and line feeds,

c. a suitable format for importation by the WIS Early Products word processing software package (which may include any of the above formats). See Appendix III for packages to be supported. Note that it is permissible to require that post-processing of data files be performed by the Early Products software in order to prepare a data file for importation by the Early Products software.

The word processing function shall [8] perform any formatting actions, paragraphing, and line wrapping actions prior to actually writing the file when using the ASCII option. The option shall [9] exist to expand tab characters into spaces when writing ASCII text files.

3.1.4.3.3.3.18. UNDO Actions

An UNDO feature that allows the operator to rescind a previously executed action shall [1] be provided by the word processor, where appropriate. The UNDO capability shall [2] restore the document to its state prior to the execution of the rescinded command. One (1) level of UNDO shall [3] be provided as a minimum capability.

3.1.4.3.3.3.19. Spell Checking

The word processor shall [1] provide a spell checking capability. The spelling checker shall [2] be capable of invocation from within the main word processor at any time during an edit session. The spelling checker shall [3] be capable of invocation starting from any point within the subject document file. When invoked, the spelling checker shall [4] indicate those words that fail to match words contained within its internal dictionary(s). The spelling checker shall [5] then provide the following minimum set of options for processing the mismatch:

a. skip over the mismatched word and continue to the search for additional mismatched words,

b. search the internal dictionary for a set of closest matches from words within the dictionary and provide for replacement by selection from that set,

c. inclusion of the word into the internal spelling dictionary,

d. replacement of the mismatched word by user-supplied replacement text, and,

e. termination of the spell checking operation.

Upon completion of the selected option, the spelling checker shall [6] continue to search for mismatched words until the end of the document file is reached, except in the case of option (e), above. When a mismatch is found, the offending word shall [7] be shown within the context of the document being scanned. The amount of surrounding text shall [8] be a minimum of two lines surrounding the offending word.

The spelling checker shall [9] provide a 80,000 (minimum) word dictionary of commonly used English words, as well as provide additional space for addition of user-defined specific words, acronyms, and jargon into the same or different dictionary. The spell checker shall [10] provide the capability to delete and correct user-defined spellings from the internal dictionary(s).

3.1.4.3.3.3.20. Thesaurus

The word processing facility shall [1] supply a thesaurus capability that allows the search for words, and word synonyms and antonyms.

3.1.4.3.3.3.21. Glossary

The word processor shall [1] provide a glossary capability where user-defined strings and/or word processor commands may be stored and recalled for later use. Glossary strings shall [2] be capable of being permanently stored, where the glossary definition is available for use whenever the word processor is invoked, stored within the specific document being edited (internally formatted documents only), and stored temporarily during the edit session. Invocation of the glossary definition shall [3] be through assignment of the definition to function keys and/or other available keyboard keys, access from a menu, or assignment of short-hand names and labels. The glossary functions shall [4] be capable of storing the entire set of codes represented by the numbers with the range of (0,255).

3.1.4.3.3.4. Print Formatting Functions

The word processor shall [1] support the specification of the following attributes for use in formatting and printing a document (in addition to the text formatting characteristics defined in 3.1.4.3.3.3.2):

a. The total number of lines per printed page,
b. The number of copies to be printed,
c. The print type, i.e., draft, correspondence, or letter quality,
d. The line spacing, i.e., single, double, space-and-half, etc,
e. The number of characters per inch (i.e., the pitch),
f. Whether printing should be continuous or stop at every page,
g. Automatic page numbering, and the starting page number for the print job,
h. The top, bottom, and left margin values,
i. Specification of starting and ending pages to print, and
j. Specification of the print font.

Each of these parameters shall [2] have an associated default value. The capability shall [3] be provided to change the default values for all word processing documents, as well as for specific documents.

3.1.4.3.4. Spreadsheet Support Services

3.1.4.3.4.1. General

The spreadsheet function shall [1] provide the capability to generate, display, review, modify, format and print, load, and store spreadsheet documents using the hardware facilities of the WIS Workstation configurations. All storage units provided as part of the WIS Workstation configurations shall [2] be supported by the spreadsheet function. All hardcopy devices (i.e., printers) provided as part of the WIS Workstation Segment shall [3] be supported by the spreadsheet function. All inherent capabilities of all WIS Workstation printers shall [4] be accessible from within the Spreadsheet Support Services software. All input devices (keyboards and pointing devices) and displays provided as part of all WIS Workstation configurations shall [5] be supported by the spreadsheet function.

The spreadsheet package shall [6] support spreadsheets that contain a minimum of 500,000 cells.

3.1.4.3.4.2. Calculation Functions

3.1.4.3.4.2.1. Basic Cell Contents

Any cell within a spreadsheet document shall [1] be capable of holding data items that are comprised of any of the types listed below:

a. Numerical data,
b. Textual strings,
c. Simple numerical expressions that include addresses to other cells, and
d. Complex macro expressions that can be viewed as "mini-programs".

3.1.4.3.4.2.2. Cell Addressing

Spreadsheet cells shall [1] be addressable for use in both expression derivation and user supplied addressing in either absolute or relative addresses. Absolute addresses do not change as the expression in a cell moves from cell to cell. Relative addresses provide cell addressing, as well, however, as expressions containing relative addresses are copied/moved to other cells, the spreadsheet maintains the relationships between the original expression cell and the referenced cells. As the expression is moved, references to relative addressed cells change to reflect the original relationships. Both relative cell and absolute cell addresses shall [2] be capable of being assigned to the expression.

The spreadsheet system shall [3] provide the capability to label specific cells, and provide reference to that cell via the assigned label.

3.1.4.3.4.2.3. Basic Expression Elements

The spreadsheet system shall [1] support the development of expressions assigned to specific cells containing the following minimum set of elements:

a. Numerical and text/string constants;
b. Cell addresses (absolute and relative);
c. The standard arithmetic operators +,-,x,÷,√,** (exponentiation);
d. The standard functions exp, log, ln, sin, cos, tan, arcsin, arccos, arctan;
e. Business and financial functions (amortization, depreciation, etc.);
f. Statistical functions (standard deviation, mean, variance, linear regression, etc.);
g. Aggregation functions (e.g., sum) that operate on rows of cells, columns of cells, or user designated areas of cells, and produce a single value;
h. System functions such as date and time; and
i. User-defined functions (see 3.1.4.3.3.2.5).

A standard set of text manipulation functions (concatenation, replacement, deletion, etc.) shall [2] support text-oriented cell expressions. Changes in cells referenced by cell expression shall [3] cause the associated expression to be evaluated and the display (if the cell is visible) updated with the result of the new evaluation.

The spreadsheet facility shall [4] adhere to accepted rules of association and distribution of mathematical operators, as well as parenthetical control of evaluation to override the association and distribution rules, when evaluating basic numerical expressions.

3.1.4.3.4.2.4. Advanced Cell Expression Elements

The spreadsheet shall [1] provide the capability to develop compound cell expressions from comparisons of simple expressions using the standard concepts of equality and ordering relationships. These expressions shall [2] be capable of being combined into larger expressions using the logical AND, OR, and NOT operators. Results of comparison and logical expressions shall [3] consist of two-valued data items (<1,0>, <TRUE,FALSE>, etc.).

3.1.4.3.4.2.5. Macro Capabilities

The spreadsheet system shall [1] support the development of user-defined macros. Standard programming concepts of iteration, choice and branching, and other similar constructs shall [2] have analogs within the macro development environment. Access to spreadsheet document handling facilities, user input facilities, spreadsheet formatting facilities, etc. shall [3] be provided as part of the macro environment.

The spreadsheet system shall [4] support two classes of macros: standalone macros, and function macros. Standalone macros support standalone processing and are evaluated for the side effects upon a spreadsheet document. Function macros are designed to calculate a value, are callable from user-defined expressions and are required to return the calculated value as a result of the macro function evaluation, in addition to side effects on the spreadsheet document.

3.1.4.3.4.2.6. Recalculation Capabilities

The spreadsheet shall [1] provide for automatic recalculation of document cells as referenced cells change through user interaction or macro processing. The spreadsheet shall [2] provide an option to toggle on/off automatic recalculation and recalculate the spreadsheet upon specific user command. The spreadsheet shall [3] optimize re-calculation operations to re-calculate only those cells affected by changes.

3.1.4.3.4.3. Display Functions

3.1.4.3.4.3.1. Alphanumeric Character Set

The spreadsheet system shall [1] be able to generate, process, and display the complete ASCII character set in accordance with the requirements of FIPS Publication 1-2.

3.1.4.3.4.3.2. Display Configuration

The spreadsheet system shall [1] support a minimum of three (3) windows. All spreadsheet capabilities shall [2] be available in any of the windows. When viewing multiple windows of data in a windowed spreadsheet screen, the source of the data shall [3] be either from multiple data files, from the same data file, or any combination thereof.

3.1.4.3.4.3.3. Scrolling

The spreadsheet facility shall [1] provide the capability for bidirectional vertical and bidirectional horizontal scrolling. Direct access to specific cells shall [2] be possible through specification of the cell's address, or optional label. When accessed, a cell and its immediate neighborhood shall [3] be displayed on the screen.

3.1.4.3.4.3.4. Cell Display

The spreadsheet facility shall [1] provide the capability to individually tailor the display of cell data. Floating point data shall [2] be capable of being displayed either in fixed point notation, with a variable number of decimal points up to a minimum of six (6) places, or in scientific notation (i.e., mantissa and exponent notation). Cells designated to contain currency figures shall [3] be displayable in "dollars-and-cents" notation. Time and date notations (HH:MM:SS, HH:MM, year/month/day, day/month/year, dd-mm-yy, etc.) shall [4] be provided for cells containing time and date data. All cells shall [5] be capable of independent justification (center-justification, right-justification, and left-justification). Data too large to fit into a single cell shall [6] extend into neighboring unoccupied cells when displayed. Cell column widths shall [7], as a minimum, be independently configurable.

3.1.4.3.4.3.5. Graphics Display

The spreadsheet shall [1] contain a capability to display a selected set of cells in the graphical structures described in 3.1.4.3.5.2, "Basic Graphics." All capabilities of 3.1.4.3.5.2 shall [2] be supported in this display mode.

3.1.4.3.4.4. Spreadsheet Processing Functions

3.1.4.3.4.4.1. Spreadsheet Generation and Review

A set of capabilities for interactive spreadsheet generation shall [1] be provided. At any point during spreadsheet generation, review, and modification, it shall [2] be possible to scroll or page the spreadsheet document to view spreadsheet areas not visible on the screen.

3.1.4.3.4.4.2. Spreadsheet Formatting

The spreadsheet facility shall [1] provide the following set of formatting capabilities:

a. Headers and footers with date, time, page number, and user-defined text,
b. Column and row headers on every page,
c. Selection of cell ranges to be printed,
d. Page margin definitions, and
e. The ability to override default formatting parameters.

3.1.4.3.4.4.3. Delete Cell Contents

The spreadsheet shall [1] provide for the deletion of data from a designated cell or cell area. The capability to undo all deletion actions shall [2] be provided.

3.1.4.3.4.4.4. Insert Cell Contents

The capability shall [1] be provided to insert data into a designated cell.

3.1.4.3.4.4.5. Edit Cell Contents

The spreadsheet function shall [1] provide the capability to edit the contents of a designated cell or range of cells. Results of cell editing the contents of a designated cell shall [2] be immediately displayed on the screen once the user indicates that editing for the subject cell is complete. Effects of cell editing on dependent cells shall [3] be displayed subject to the recalculation option currently in force (see 3.1.4.3.3.2.6).

3.1.4.3.4.4.6. String Search

The spreadsheet shall [1] provide the capability to search for a user-designated string within a spreadsheet document, as well as in a user-designated range of cells within a document. This capability shall [2] apply to both literal data and expressions. This capability shall [3] include the ability to find the first occurrence of a string, the last occurrence of a string, and the next occurrence of a string (stepping ability). Searching shall [4] be capable of invocation at any point within the document and, as a minimum capability, shall [5] proceed forward from the point of last invocation through the document, stopping at the end of the document.

3.1.4.3.4.4.7. Search and Replace

The spreadsheet shall [1] provide the capability to modify cell contents found during a string search operation. The spreadsheet package shall [2] provide the capability to manually replace each matched string with user-entered replacement text and continuing the search (i.e., "manual search-and-replace"), as well as provide for automatically replacing each instance of matched text with user-designated replacement text (i.e., "global search and replace").

The manual search-and-replace function shall [3] provide a "skip" capability which will cause the search-and-replace to find the next occurrence of the search string, leaving the current occurrence alone. The manual search-and-replace function shall [4] provide the capability to re-enter the spreadsheet editing

functions to allow for more extensive editing, and re-entering the search-and-replace operation at the point it was interrupted when the editing is completed. Global search and replace operations shall [5] be capable of being started at any point during a manual search and replace operation.

Automatic re-formatting of the display shall [6] be accomplished as text is replaced at each instance, for both manual and global search-and-replace operations. Re-calculation of the spreadsheet shall [7] be accomplished for dependent cells, depending on the state of the re-calculation control state.

3.1.4.3.4.4.8. Move Cell Data Within Files

The spreadsheet shall [1] provide the capability to move designated groups of cell data from one position in a spreadsheet document to another position (i.e., "cut and paste"). Movement shall [2] be unconstrained by defined spreadsheet boundaries or display size. The cell data moved shall [3] be deleted from the source position in the document. Relatively referenced cells within moved expressions shall [4] be automatically updated. The spreadsheet shall [5] provide the capability to perform multiple paste operations at multiple locations within the document.

3.1.4.3.4.4.9. Copy Cell Data Within Files

The spreadsheet shall [1] provide the capability to copy designated groups of cell data from one position in a file to another position (i.e., "copy and paste"). Movement shall [2] be unconstrained by defined spreadsheet boundaries or display size. The cell data moved shall [3] be retained within the source position in the document. Relatively referenced cells within moved expressions shall [4] be automatically updated. The spreadsheet shall [5] provide the capability to perform multiple paste operations at multiple locations within the document.

3.1.4.3.4.4.10. Move Cell Data Between Files

The spreadsheet shall [1] provide the capability to designate cell text and move said text into another document (i.e., "cut-and-paste"). This capability shall [2] delete designated text from the source document. The system shall [3] permit simultaneous display of the both the text being generated and the file from which the text will be withdrawn for insertion. Recalculation and display updating shall [4] occur as the new data is inserted into the destination document. The spreadsheet shall [5] provide the capability to perform multiple paste operations at multiple locations within the destination document.

3.1.4.3.4.4.11. Copy Cell Data Between Files

The spreadsheet shall [1] provide the capability to designate cell text and move said text into another document (i.e., "copy-and-paste"). This capability shall [2] retain designated text in the source document. The system shall [3] permit simultaneous display of the both the text being generated and the file from which the text will be withdrawn for insertion. Recalculation and display updating shall [4] occur as the new data is inserted into the destination document. The spreadsheet shall [5] provide the capability to perform multiple paste operations at multiple locations within the destination document.

3.1.4.3.4.4.12. Merge Spreadsheets

The spreadsheet shall [1] provide a capability to merge a separate spreadsheet document, and/or groups of spreadsheet documents in a user-specified order to create a new spreadsheet document.

3.1.4.3.4.4.13. Loading Spreadsheets

The spreadsheet shall [1] provide the ability to import/load files in any of the following formats at any time during a spreadsheet session:

a. Spreadsheet internally formatted files,
b. DIF compatible files,
c. ASCII (text) files, and
d. Files suitably formatted for exportation by the WIS Early Products spreadsheet package (which may include any of the above formats).

For DIF and ASCII files, the spreadsheet shall [2] provide the option of conversion of those files into internally formatted files. Importation of files, in any of the previously mentioned formats, shall [3] be provided at any designated point within a document, for incorporation of previously existing spreadsheet data into a newly edited document.

3.1.4.3.4.4.14. Saving Spreadsheets

At any stage during the composition or review of a spreadsheet document, the spreadsheet shall [1] be capable of saving the state of the document in a designated file. The spreadsheet shall [2] overwrite the input file if no file is designated for saving. The spreadsheet shall [3] support a mode where such overwrite save action will result in a verification request being generated and acted upon prior to execution of the save operation.

The spreadsheet shall [4] provide the option of saving the file in any one of the following formats:

a. The internal format supported by the spreadsheet,
b. An ASCII "text" format where the file contains only displayable ASCII text and line control characters such as carriage returns and line feeds,
c. Data Interchange Format (DIF) compatible files, and
d. A suitable format for importation by the WIS Early Products spreadsheet software package (which may include any of the above formats, see Appendix I).

The spreadsheet function shall [5] perform any formatting actions prior to actually writing the file when using the ASCII option. The option shall [6] exist to expand tab characters into spaces when writing ASCII text files.

3.1.4.3.4.5. Print Formatting Functions

The spreadsheet shall [1] provide the capability to specify the following attributes for printing a document (in addition to the format controls in 3.1.4.3.3.4.2):

a. The total number of lines per printed page;
b. The number of copies to be printed;
c. The print quality, i.e., draft, correspondence, or letter quality;
d. The line spacing, i.e., single, double, space-and-half, etc;
e. The number of characters per inch (i.e., the pitch);
f. Whether printing should be continuous or stop at every page;

g. Automatic page numbering, and the starting page number for the print job;
h. The top, bottom, and left and right margin values; and
i. Range of cells to print.

Each of these parameters shall [2] have a default value associated. Users shall [3] have the option of changing the default values either for all spreadsheet documents, and for specific documents.

The spreadsheet facility shall [4] be capable of plotting graphical displays of selected data on all graphics oriented workstation printers (Color Graphics printer, Page-Oriented printer).

The spreadsheet shall [5] provide a means of sending commands to the printer to control its actions. Such control information might be change font, do a page feed action, increase the print size, add characteristics such as bolding, and other like actions.

The spreadsheet facility shall [6] provide a capability to print a large document "sideways" when printing to printers that support fanfold paper.

3.1.4.3.5. Database Management System Support Services

3.1.4.3.5.1. General

The following paragraphs describe the minimum requirements for local database management system services to be provided on all WIS Workstation equipment (both Basic and Target configurations). The database management system provided to meet these requirements shall [1] support and implement a relational data model. A relational data model is defined as a database structuring methodology where the database consists of set of "flat" two-dimensional tables or relations which consist of "rows" or "tuples" of data containing "attributes" or "fields" with specific instances of data within the domain defined for that attribute.

The database management system shall [2] provide the ability to rescind actions that have caused a modification of the database, and restore the database to the state prior to execution of that action. Rescinding of modifications to the data, database schema, and associated reports, as a minimum, shall [3] be supported. The database management system shall [4] provide a minimum of one (1) level of backtracking necessary to support this "UNDO" requirement. Once an action has been committed, it is not required that the action be "undo-able."

All storage units provided as part of the WIS Workstation configurations shall [5] be supported by the database management function. All hardcopy devices (i.e., printers) provided as part of the WIS Workstation Segment shall [6] be supported by the database management function. All inherent capabilities of all WIS Workstation printers shall [7] be accessible from within the Database Management System Support Services software. All input devices (keyboards and pointing devices) and displays provided as part of all WIS Workstation configurations shall [8] be supported by the database management function.

3.1.4.3.5.2. Data Types

The database management system shall [1] support the following data types, as a minimum:

a. Integer data types,
b. Floating point data types,

c. Date/time data types,
d. Character data types, and
e. Logical (i.e., two-valued) data types.

3.1.4.3.5.3. Data Base Definition

3.1.4.3.5.3.1. Operations

The WIS Workstation Database Management System shall [1] provide capabilities that allow the user to define and modify overall data base definitions, tables contained within databases, and attributes of data fields associated with each database table. These operations shall [2], as a minimum, include:

a. Create table definitions,
b. Delete table definitions,
c. Edit table definitions,
d. Create field descriptions,
e. Delete fields from tables,
f. Edit field descriptions associated with database tables,
g. Create/Delete/Edit data entry forms, and
h. Create/Delete/Edit report generation forms and procedures.

Modification of table definitions when tables contain data rows shall [3] be permitted with database updating performed upon user command.

3.1.4.3.5.3.2. Field Definitions

Fields in a database shall [1] be capable of being designated as either "primitive" data fields, or as "derived" data fields. "Primitive" data fields shall [2] be defined as data fields that contain the fundamental data present in the database. "Derived" fields shall [3] be defined as fields which contain data derived from the primitive fields, or other derived fields, by application of mathematical formulas (for numeric fields), character expressions and operations (for text fields), or logical expressions (for logical fields). The database management system shall [4] provide two methods to derive values for derived fields: permanent and temporary. Permanent derivations, which occur during loading or modification of primitive data fields, shall [5] physically load and modify the value of the derived field once all primitive fields upon which the calculation is dependent are known or have been changed. Temporarily derived fields shall [6] provide values during query processing, report processing, and when other references against the data field are requested, however, the value is not physically retained in the database.

3.1.4.3.5.3.3. Limits

The database management system shall [1] provide for at least a maximum row size of 4096 bytes. A database definition shall [2] allow for an unlimited number of tables per database. A database definition shall [3] provide the capability for defining tables with the number of attributes assigned to the table equal to the maximum data length of the record, in bytes, i.e., where the table contains the number of 1-byte data types that can fit in a record of the given maximum size. The number of rows contained in a database shall [4] be constrained only by the physical storage available within the disk system.

3.1.4.3.5.3.4. Indices

Indices shall [1] be definable for any field within the database. Multiple instances of data rows with same value for the indexed variable shall [2] be supported when building indices. Indices shall [3] be capable of being marked as "keyed" indicating that each row must contain a unique value for the indexed variable. All related indices shall [4] be automatically updated as rows and data fields are inserted, modified, and deleted.

3.1.4.3.5.3.5. Data Dictionary

All information about a database and its structure shall [1] be collected and maintained in a data dictionary associated with the database. The database management systems shall [2] provide access to on-line queries against the data dictionary.

The information retained and managed within the data dictionary shall [3] include, as a minimum:

a. Table definitions including table names, fields within table, number of rows in table, and date and time last modified;

b. Field definitions including field names, types, number of bytes for field, start position within the record, indexed flag (indicating whether field is indexed), and formulas (for derived fields); and

c. Procedure definitions for command-language based procedures.

Access to the table and field definitions maintained within the data dictionary shall [4] be provided for use by application programs. Utilities shall [5] be provided that read the table and field definitions and produce Ada-based data definitions for use with applications programs.

3.1.4.3.5.4. Data Entry

3.1.4.3.5.4.1. Command-Based Entry

The database facility shall [1] provide the capability to enter data into the database tables by issuance of direct user commands to the database system. Data sources shall [2] include, as a minimum: user command lines from the keyboard, text files resident on disk, other database tables within the database, and other database files.

Permanently derived fields and indices shall [3] be automatically updated as a result of command-based data entry.

Command-based data entry shall [4] support the application of data constraint rules against new data rows, which are entered by the user to flag erroneous input, or other constraint violations designated necessary by the user, as data is entered into the database. Entry constraint rules shall [5] be capable of using data in the current data row being entered, as well as data fields from other rows within the same table, and data from other qualified rows in other tables within the database. Constraint checking shall [6] be capable of being toggled on/off prior to loading data into the database.

3.1.4.3.5.4.2. Forms-Based Entry

The database facility shall [1] provide the capability to enter data into the database tables by use of a data entry form capability to allow entry and preliminary editing of data prior to entry into the database. The forms entry method shall [2] provide for the development of user-defined forms. The forms entry mode shall [3] provide error detection and correction capabilities prior to data entry based on violations of the data field definitions (e.g., length, type, etc.). The forms entry method shall [4] provide the capability to enter one record or multiple records of data. User forms shall [5] be capable of to accessing other database tables to retrieve relevant rows for display in the form, constraint checking, etc.. Permanently derived fields and indices shall [6] be automatically updated as a result of data entry.

All permanently derived fields and indices associated with fields being entered shall [7] be updated as a result of forms-based data entry.

Forms-based data entry shall [8] support the application of data constraint rules which are entered by the user to flag erroneous input, or other constraint violations designated necessary by the user, as data is entered into the database. Entry constraint rules shall [9] be capable of using data in the current data row being entered, as well as data fields from other rows within the same table, and data from other qualified rows in other tables within the database. Constraint checking shall [10] be capable of being toggled on/off prior to loading data into the database.

3.1.4.3.5.5. Data Editing

3.1.4.3.5.5.1. Command-Based Editing

The database management system on the WIS Workstation shall [1] provide for editing of data previously entered into the database, through the issuance of user commands to directly edit data rows; that is, editing is performed through the application of modification commands (DELETE, CHANGE, etc.) applied to qualifying rows. The database management system shall [2] provide the capability to designate the entire set of rows within a table as being subject to editing. The database management system shall [3] be capable of designating a subset of the data rows within a table as being subject to editing using the query facility to perform the qualification.

All permanently derived fields and indices shall [4] be updated as data rows are modified or deleted. Command-based editing shall [5] be capable of executing user-designated constraint rules as data rows are edited and re-saved into the database. Rows violating those constraints shall [6] be flagged for attention.

3.1.4.3.5.5.2. Forms-Based Editing

The database management system on the WIS Workstation shall [1] provide for editing of data previously entered into the database, through use of the forms-based data entry capabilities. The database management system shall [2] provide the capability to designate the entire set of rows within a table as being subject to editing using forms-based editing. The database management system shall [3] be capable of designating a subset of the data rows within a table as being subject to forms-based editing using the query facility to perform the qualification.

All permanently derived fields and indices shall [4] be updated as data rows are modified or deleted.

Forms-based editing shall [5] be capable of executing user-designated constraint rules as data rows are edited and re-saved into the database. Rows violating those constraints shall [6] be flagged for attention. Constraint violations related to violation of forms and field definition conditions developed as part of the data entry form shall [7] be reported during forms-based data editing sessions.

3.1.4.3.5.6. Data Base Querying

The WIS Workstation database management system shall [1] provide the capability for user-defined queries to be generated, entered, and acted upon by the system. Querying shall [2] be provided as a separate function to ascertain the contents of the database, as part of the report generating function, and as part of the data editing function. Reports shall [3] be able to have queries as part of the definition of the report. Users shall [4] be able to qualify rows in the database that will be reported using a specific report. User shall [5] be able to qualify rows that will be edited by the data edit function using query functions.

The query facility shall [6] provide an ANSI/SQL interface to the query function as defined in FIPS Publication 127. Other interfaces may be provided.

Queries shall [7] be capable of being entered directly. Capabilities shall [8] be provided that can be used to interactively build a query from the database definition, and user-supplied direction.

The query function shall [9] support several potential query strategies that can be tailored and evaluated prior to query processing to determine the most appropriate strategy for given query circumstance. The database query function shall [10] be capable of using the information retained in the data dictionary (number of rows, variables with associated indices, etc.) to optimize the query strategy and reduce the time required to execute the query and retrieve the results.

The results of queries not associated with a report or data entry/editing action shall [11] be capable of being displayed on the workstation display system, printed on an attached workstation printer, or saved in a workstation disk file. New relations shall [12] be capable of being created as the result of the execution of a query.

3.1.4.3.5.7. Report Generation

The database management system shall [1] provide the capability to generate reports from the contents of the database. The user shall [2] be able to qualify rows in the database that will be reported. Reports shall [3] allow for cross-relation qualification and reporting of data rows.

Reports shall [4] provide for user-defined placement of data fields. Fields that result from computations derived from existing "primitive" data fields shall [5] be supported. Aggregation functions for computation of totals, averages, counts, and other such functions shall [6] be provided. The user shall [7] be able to control the starting and restarting of aggregation. The report system shall [8] provide for user definition of labels, text, margins, pagination control, headers, footers, date and time placement,and other formatting capabilities.

The report function shall [9] support sorting of data rows prior to reporting. Sorts shall [10] be performed either in ascending or descending order. A minimum of five sort key variables shall [11] be allowed to control the sort. Sort order for each sort.key variable shall [12] be independent of the other

variables. Sorts on multiple keys are assumed to essentially generate a "super-key" that consists of the concatenation of all sort keys, along with sort order.

Reports shall [13] be capable of being generated for display on the workstation display system, for immediate printing on an attached workstation printer, or to a disk file for use in subsequent processing.

3.1.4.3.5.8. Data Base Procedure Definition

The database management system shall [1] provide a procedure definition facility that allows users to define explicit processing procedures, and store them for use in manipulating the database. The procedure facility shall [2] support a type of compilation feature allowing the procedures to be compiled into an intermediate representation that provides performance enhancements over and above the normal use of the procedure.

3.1.4.3.5.9. Data File Importation

The database management system shall [1] be capable of reading data files compatible with, or generated from, the WIS Early Products database management system (see Appendix III). Pre-processing of Early Products database files by the Early Products database management system is permitted; generalized procedures for preparing Early Products database files shall [2] be prepared to guide in the conversion of database files. The database management system report facility shall [3] be capable of generating disk files from database management system files that can be used to export data to the Early Products database management system.

3.1.4.3.6. Graphics Support Services

3.1.4.3.6.1. General

A graphics processing capability is required for all WIS Workstation configurations. The graphics capability shall [1] provide the following functions:

a. Basic Graphics - Creation of line, bar, pie charts,
b. Project Management Graphics - Creation of PERT, GANTT, time line charts,
c. Free-Form Drawing Graphics - Creation of charts using free-form drawing techniques, and
d. Briefing Aids - Coordination of a series of charts into a presentation.

All graphics software provided to meet the requirements of this paragraph shall [2] be capable of producing the appropriate charts on all workstation displays defined in section 3.3. All graphics software provided to meet the requirements of this paragraph shall [3] be capable of producing the appropriate charts on the Color Graphics Printer, and the Page-Oriented Printer, as defined in section 3.3. All functions, capabilities, and features of the various output devices shall [4] be exploitable by all of the graphics capabilities described herein.

The graphics capability shall [5] allow the incorporation of charts from any of the capabilities (a - c) above into an integrated graphics presentation that is built, edited, and coordinated by capability (d) above. Capability (d) above shall [6] allow the incorporation of graphics charts derived from the integrated software suite defined in paragraph 3.1.4.3.2 into any given presentation. All graphics software

shall [7] execute correctly within the native environment provided by the Basic and Target Workstation multi-tasking operating systems.

3.1.4.3.6.2. Basic Graphics

The Basic Graphics processing facility shall [1] provide the capability to create, edit, display, save, or to retrieve the following charts:

a. Horizontal and vertical bar charts,
b. Histograms,
c. Point charts,
d. Line charts, and
e. Pie charts.

3.1.4.3.6.2.1. Basic Graphics Labelling

The Basic Graphics package shall [1] provide the capability to adjust the labels associated with a chart. For chart formats requiring two (or more) axes, each axis label shall [2] be adjustable independently of the remaining axes. Labelling shall [3] consist of both textual and graphic elements. The Basic Graphics package shall [4] provide a library of label symbols that can be used for labelling points, curves, and other chart elements. The Basic Graphics package shall [5] be capable of associating labels with data points, curves, histogram bars, and pie slices. Labelling shall [6] be capable of producing text using a variety of fonts, and character styles. At a minimum, a san serif and serif typeface containing both the normal alphabetic and mathematical symbols in point sizes ranging from 9 to 18 points shall [7] be supplied with the Basic Graphics package to support labelling functions. The Basic Graphics package shall [8] allow the editing of all label data, including symbolology, appearance, typeface, and style.

3.1.4.3.6.2.2. Basic Graphics Annotation

The Basic Graphics package shall [1] allow annotations of the charts to be developed and placed within the chart. Annotations shall [2] include, as a minimum, areas containing arbitrary text as well as legends. All text functions available for labelling shall [3] be available for annotation, as well. The Basic Graphics package shall [4] allow the editing of all annotation data, including appearance, typeface, and style.

3.1.4.3.6.2.3. Basic Graphics Scaling

The Basic Graphics Package shall [1] permit the changing of axis scales, and the automatic re-adjustment of the chart to fit within the new axes. The Basic Graphics Package shall [2] permit changing the overall chart size and aspect ratio.

3.1.4.3.6.2.4. Basic Graphics Rotation

The Basic Graphics Package shall [1] permit rotations of the chart, as a minimum, about the X, Y, and Z axes in order to provide the capability to rotate the chart (Z-axis) or flip the chart (X- and Y-axes). Rotations shall [2], at a minimum, be allowed in steps of 45°.

3.1.4.3.6.2.5. Basic Graphics Editing

The Basic Graphics package shall [1] permit the editing of a chart to change various aspects of visual appearance of the chart including the labelling, symbology, aspect ratio, annotation, scaling, rotation, and other chart aspects.

3.1.4.3.6.2.6. Loading Basic Graphics Data Files

The Basic Graphics package shall [1] provide the capability to load a chart from the WIS Workstation disk system, previously saved. All aspects of the chart shall [2] be restored and re-displayed when the chart is loaded.

3.1.4.3.6.2.7. Saving Basic Graphics Data Files

The Basic Graphics package shall [1] provide the capability to save a chart on the WIS Workstation disk system, for later recall and editing. All aspects of the chart shall [2] be saved for restoral when the chart is later recalled.

3.1.4.3.6.2.8. Importing Data Files into Basic Graphics

The Basic Graphics package shall [1] permit the following options, as a minimum, for entering the data that is to be graphically depicted by the package:

a. Data entry from the keyboard. All data entered from the keyboard shall [2] be editable by the data entry function. The Basic Graphics package shall [3] permit saving all data entered from the keyboard in a disk file that can be read the data file entry function (b), and

b. Data entry from a disk file. All data entered from a disk file shall [4] be editable using the keyboard data entry function, above.

Data file formats to be supported shall [5] include all the formats supported by the spreadsheet function (3.1.4.3.4), as well as the internal formats of the package. The Basic Graphics package shall [6] permit saving all data entered in a disk file that can be re-read the data file entry function. Data sets shall [7] derivable from a combination of both keyboard and data file entry methods.

3.1.4.3.6.3. Project Management Graphics

The project management graphics processing facility shall [1] provide the capability to create, edit, display, save, or to retrieve the following charts:

a. PERT charts.
b. GANTT charts, and
c. Timeline and milestone charts.

All charts shall [2] be derived from a common set of scheduling and task description data for a specific project. The project management graphics package shall [3] determine critical paths, when desired. Critical path display shall [4] be supported as part of a PERT chart display.

3.1.4.3.6.3.1. Project Management Graphics Labelling

The Project Management Graphics package shall [1] provide the capability to adjust the labels associated with a chart. For chart formats requiring two (or more) axes, each axis label shall [2] be adjustable independently of the remaining axes. Labelling shall [3] consist of both textual and graphic elements. The Project Management Graphics package shall [4] provide a library of label symbols that can be used for labelling points, curves, and other chart elements. Labelling shall [5] be capable of producing text using a variety of fonts, and character styles. At a minimum, a san serif and serif typeface containing both the normal alphabetic and mathematical symbols in point sizes ranging from 9 to 18 points shall [6] be supplied with the Project Management Graphics package to support labelling functions. The Project Management Graphics package shall [7] allow the editing of all label data, including symbolology, appearance, typeface, and style.

Time-based labels shall [8] be provided in the following categories, at a minimum: months, years, quarters. Months shall [9] capable of denotation using both the position within the year (i.e., 1 through 12), and by name (January through December).

3.1.4.3.6.3.2. Project Management Graphics Annotation

The Project Management Graphics package shall [1] allow annotations of the charts to be developed and placed within the chart. Annotations shall [2] include, as a minimum, areas containing arbitrary text as well as legends. All text functions available for labelling shall [3] be available for annotation as well. The Project Management Graphics package shall [4] permit editing of the text and legend data as part of the annotation function.

3.1.4.3.6.3.3. Project Management Graphics Scaling

The Project Management Graphics Package shall [1] permit the changing of axis scales, and the automatic re-adjustment of the chart to fit within the new axes. The Project Management Graphics Package shall [2] permit changing the overall chart size and aspect ratio.

3.1.4.3.6.3.4. Project Management Graphics Rotation

The Project Management Graphics Package shall [1] permit rotations of the chart, as a minimum, about the X, Y, and Z axes in order to provide the capability to rotate the chart (Z-axis) or flip the chart (X- and Y-axes). Rotations shall [2], at a minimum, be allowed in steps of 90°.

3.1.4.3.6.3.5. Project Management Graphics Editing

The Project Management Graphics package shall [1] permit editing of a chart to change various aspects of visual appearance of the chart including the labelling, symbology, aspect ratio, annotation, scaling, rotation, and other chart aspects.

3.1.4.3.6.3.6. Loading PM Graphics Data Files

The Project Management Graphics package shall [1] provide the capability to load a chart from the WIS Workstation disk system, previously saved. All aspects of the chart shall [2] be restored and re-displayed when the chart is loaded.

3.1.4.3.6.3.7. Saving PM Graphics Data Files

The Project Management Graphics package shall [1] provide the capability to save a chart on the WIS Workstation disk system, for later recall and editing. All aspects of the chart shall [2] be saved.

3.1.4.3.6.3.8. Importing Data Files into PM Graphics

The Project Management Graphics package shall [1] permit the following options, as a minimum, for entering the data that is to be graphically depicted by the package:

a. Data entry from the keyboard. All data entered from the keyboard shall [2] be editable by the data entry function. The Project Management Graphics package shall [3] permit saving all data entered from the keyboard in a disk file that can be read the data file entry function (b), and

b. Data entry from a disk file.

All data entered from a disk file shall [4] be editable using the keyboard data entry function, above. Data file formats to be supported shall [5] include all the formats supported by the spreadsheet function (3.1.4.3.4), as well as the internal formats of the package. The Project Management Graphics package shall [6] permit saving all data entered in a disk file that can be re-read the data file entry function.Data sets shall [7] derivable from a combination of both keyboard and data file entry methods.

3.1.4.3.6.4. Free-Form Drawing Graphics

The free-form graphics processing facility shall [1] provide the capability to create, edit, display, save, or retrieve charts that contain the following graphic elements:

a. Bit-mapped pictures and picture elements,
b. Graphics object elements (circles, lines, boxes, etc.), and
c. Text.

The free-form graphics processing facility shall [2] provide the capability to add, delete, and manipulate these graphics elements within a chart. Text shall [3] be manipulated by the free-form drawing software as a graphics object.

3.1.4.3.6.4.1. Free-Form Graphics Positioning

The Free-Form Drawing Graphics capability shall [1] provide the capability to move and place arbitrary graphics elements (bit-mapped pictures and objects) at arbitrary locations within a chart. Rulers and other reference guides shall [2] be provide to facilitate the accurate positioning of graphics elements.

3.1.4.3.6.4.2. Free-Form Graphics Styles

The Free-Form Drawing Graphics capability shall [1] provide a variety of fill patterns for filling graphics objects. The Free-Form Drawing Graphics capability shall [2] provide several line types for drawing lines and to form the outlines of graphics objects.

3.1.4.3.6.4.3. Free-Form Graphics Scaling

The Free-Form Graphics Package shall [1] permit the changing of the scaling of the chart to fit within the new axes. The Free-Form Drawing Graphics Package shall [2] permit changing the overall chart size and aspect ratio. The Free-Form Drawing Graphics shall [3] permit the scaling and re-sizing of individual graphics objects (not necessarily bit-mapped pictures).

3.1.4.3.6.4.4. Free-Form Graphics Rotation

The Free-Form Drawing Graphics Package shall [1] permit rotations of the chart, as a minimum, about the X, Y, and Z axes in order to provide the capability to rotate the chart (Z-axis) or flip the chart (X- and Y-axes). Rotations shall [2], at a minimum, be allowed in steps of 45°. The Free-Form Drawing Graphics software shall [3] permit the rotation of individual graphics elements as well as the entire chart.

3.1.4.3.6.4.5. Free-Form Graphics Editing

The Free-Form Drawing Graphics package shall [1] permit editing of a chart to change various aspects of visual appearance of the chart including the labelling, symbology, aspect ratio, annotation, scaling, rotation, and other chart aspects.

3.1.4.3.6.4.6. Loading Free-Form Graphics Data Files

The Free-Form Drawing Graphics package shall [1] provide the capability to load a chart from the WIS Workstation disk system, previously saved. All aspects of the chart shall [2] be restored and re-displayed when the chart is loaded.

3.1.4.3.6.4.7. Saving Free-Form Graphics Data Files

The Free-Form Graphics package shall [1] provide the capability to save a chart on the WIS Workstation disk system, for later recall and editing. All aspects of the chart shall [2] be saved for restoral when the chart is later recalled.

3.1.4.3.6.5. Briefing Aids

All WIS Workstations shall [1] correctly execute software that provides a capability to build, organize, edit, and present slide briefings and presentations from a series of charts.

The Briefing Aids software shall [2] be capable of using any of graphics generated by the other Graphics function components (Basic, Project Management, and Free-Form Drawing packages). The Briefing Aids software shall [3] be capable of arranging the graphics charts into a series of slides. The Briefing Aids software shall [4] be capable of changing the organization of the slide presentation. Free-form drawing capabilities similar to capabilities found in 3.1.4.3.6.4 shall [5] be provided as well in the this package.

The software shall [6] provide the capability to use the workstation display as a presentation vehicle by presenting each chart from the presentation on the display upon request. Request mechanisms shall [7] include both a manual request mechanism, where the chart remains displayed until requested to change by the presenter, and a timed request mechanism, where the chart is shown for a settable period of

time before proceeding to the next chart. The timed request mechanism shall [8] support a manual override capability where the presenter can display the chart for a period of time shorter or longer than the requested period. The Briefing Aids software shall [9] provide the capability to override the sequencing of the charts during the presentation, and shall [10] provide the related capability to skip over a series of charts.

3.1.4.3.7. VT-240 Terminal Emulation Services

All WIS Workstations shall [1] support a telecommunications facility for communications with various hosts (primarily the LAN CC/SM) over asynchronous serial lines. The facility shall [2] provide the following set of capabilities:

a. Provide an emulation of Digital Equipment Corporation VT-240 terminal protocols, or equivalent terminal protocol. Mapping of VT-240 keys to physical keys on the WIS Workstation keyboard shall [3] be modifiable by the user.

b. Provide a ASCII text upload/download capability between the WIS Workstation and the host, where the entire ASCII character set as defined in FIPS Publication 1-2 can be transferred between the two systems.

c. Provide file transfer protocols to provide reliable file transfer facilities. All aspects of the protocols shall [4] be settable by the user.

The telecommunications facility shall [5] be capable of using any of the serial ports provided in 3.1.7.3.2.

3.1.4.4. Advanced Computational Support Services (GRAY)

Simulation and modelling services are required for the WIS Workstation in order to support various plan preparation and evaluation activities, as well as provide general support for various estimating and data modelling tasks. All simulation and modelling capabilities shall [1] operate correctly on all WIS Workstation systems (Basic and Target).

3.1.4.4.1. General

Advanced Computational Services are required for the WIS Workstation in order to support various plan preparation and evaluation activities, as well as provide general support for various estimating and data modelling tasks. All Advanced Computational Services shall [1] operate correctly on all WIS Workstation systems (Basic and Target). All Advanced Computational Services shall [2] operate within the native operating system environment supplied by the Basic and Target WIS Workstation multi-tasking operating systems.

3.1.4.4.2. Simulation Services

A simulation language shall [1] be supplied as the major component of Advanced Computational Support Services software. The simulation language shall [2] provide, as a minimum, the following sets of simulation methodologies:

a. A continuous modelling methodology whereby sets of ordinary differential equations may be defined and numerically integrated. The language software shall [3] provide

multiple integration algorithms of varying complexities and capabilities.

b. A discrete modelling methodology whereby sets of difference equations may be defined and solved.

c. A discrete event modelling methodology whereby the state of the simulation is advanced through time as a function of the events that scheduled and processed.

All methodologies shall [4] be provided in a manner such that "mixed mode" models may be developed using combinations of the above methodologies in a single simulation.

The simulation language shall [5] provide the capability to incorporate program code written in other languages (Ada, C, Assembler, etc.). The simulation language shall [6] provide capabilities to read data from the keyboard and from the disk system. The simulation language shall [7] provide capabilities to print data to the printers, disk files, and displays. The simulation language shall [8] provide capabilities to plot data series on the workstation displays, and graphics printers. Similar capabilities as defined in 3.1.4.3.6.2 for the Basic Graphics shall [9] be provided to allow for tailoring of simulation-defined plots. The simulation language system shall [10] provide the capability to compile simulation models and save them as multi-tasking operating system compatible executable program files.

3.1.4.4.3. Data Modelling Services

Data modelling software shall [1] be provided as part of the Advanced Computational Services on all WIS Workstations. Data modelling software shall [2] supply the following capabilities to aid in the interpretation of data:

a. Parametric and non-parametric statistical estimation software to characterize data arising from random processes.

b. Curve fitting and modelling software that provides fitting of data to analytic functions for use in further processing,

c. Function evaluation and plotting and display software to graphically display the data for further analysis.

All WIS Workstation disk systems shall [2] be supported by the data modelling software. All WIS Workstation Segment printers shall [3] be supported by the data modelling software. All WIS Workstation Segment displays shall [4] be supported by the data modelling software. The data modelling software shall [5] be capable of reading data to be manipulated from the keyboard, and from WIS Workstation disk files.

3.1.4.4.4. Artificial Intelligence Services

All WIS Workstation shall [1] support the use of artificial intelligence (AI) applications as part of the Advanced Computational Support Services software. The artificial intelligence software shall [2] provide the following capabilities:

a. The capability to correctly execute a LISP interpreter and compiler. The LISP system shall [3] adhere to the specifications of Common LISP as defined in [Steele, 1984].

b. The capability to correctly execute a PROLOG interpreter.

c. The capability to build and execute expert systems. The expert system development environment shall [3] have the capability to incorporate into expert systems based on the following minimum set of knowledge representation schemes:

1. Rule-based expert systems,
2. Frame-based (networked) expert systems, and
3. Bayesian (Probabilistic) expert systems.

The expert system shell shall [4] allow development of "mixed mode" expert systems where all supported knowledge representation schemes can be exploited in any given expert system. The expert system inference engine shall [5] support both forward and backward chaining inference models. The expert system shell inference engine shall [6] allow both inference models to be exploited in the same expert system.

All AI software shall [7] support the capability to access data and schema information maintained by the WIS Workstation database management system. All AI software shall [8] support the capability to use programs, subroutines, and other code components developed using the WIS Workstation language translation software.

3.1.5. System Functional Relationships

This paragraph is not applicable to this specification.

3.1.6. Configuration Allocation

This paragraph is not applicable to this specification.

3.1.7. Interface Requirements

3.1.7.1. External Interfaces

3.1.7.1.1. External Systems Description

The WIS Workstations (Basic and Target) are required to provide interfaces to the following external host equipment as part of the overall WIS architecture and design:

a. The WWMCCS ADP Honeywell H6000, DPS-8, DPS-6, DN-8, and Level 6 systems;
b. The Joint Mission Processing Element (JMPE) systems;
c. The Automated Message Handler (AMH) system; and
d. Any associated Service/Command Unique (S/CU) hosts resident on a WIS configuration.

Access to the WWMCCS ADP system, the JMPE systems, the AMH system, and any S/CU systems will be possible via the WIS LAN. Access to the WWMCCS ADP system shall [1] be possible via a direct connection to WWMCCS host equipment configurations.

Accessible host equipment will be located at either the local site, or at remote sites accessible through WIS LAN gateway and the Defense Data Network (DDN), or through the existing WWMCCS Interconnection Network Communications System (WINCS).

3.1.7.1.2. External Interface Identification

The WIS Workstation is required to support the following external interfaces:

a. X.25 based LAN Interface connection (3.1.7.1.3.3),
b. IEEE 802.3 based LAN Interface connection (3.1.7.1.3.4),
c. WWMCCS ADP Host direct connection (3.1.7.1.3.2), and
d. Other various interfaces (3.1.7.3).

The X.25 based LAN Interface can be used by either the LAN IU Interface Software (3.1.7.1.4.1) in circumstances where the workstation is to be connected to the Block A LAN IU, the TCP/IP Interface software (3.1.7.1.4.2) when considering remote workstations connected to a WIS LAN via a WIS gateway and DDN, or GOSIP based Interface software (3.1.7.1.4.3 and 3.1.7.1.5.3) when considering remote workstations within a GOSIP protocol framework.

The IEEE 802.3 based LAN Interface can be used by either the TCP/IP Interface software to support direct connection of the workstation to an IEEE 802.3 LAN using TCP/IP, or by GOSIP protocol software when the WIS LAN migrates to a GOSIP based protocol architecture.

3.1.7.1.3. Hardware-to-Hardware External Interfaces

3.1.7.1.3.1. COMSEC Requirements (GRAY)

All workstation-to-host interface controllers, i.e., the WWMCCS direct connect interface, X.25 based LAN hardware interface, and IEEE 802.3 LAN hardware interface, shall [1] be capable of incorporating and/or using embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the external device and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.1.7.1.3.2. WIS Workstation to WWMCCS Host Hardware Interface

All WIS Workstations (Basic and Target) shall [1] provide a direct electrical connection interface to the current WWMCCS ADP systems (i.e., the Honeywell H6000, DPS-8, DPS-6, DN-8, and Level 6 computer systems) in accordance with DCA Circular 370-P 185-15, **World Wide Military Command and Control System (WWMCCS) Automated Data Processing (ADP) Standard Telecommunications Engineering Practices,** as backend terminals without requiring a connection to the WIS LAN. The connection shall [2] be a synchronous half-duplex electrical connection transmitting data at the following minimum data rates: 1200, 2400, 4800, 9600, and 19,200 bits per second, in accordance with joint FIPS Publications 16-1, 17-1, and 22-1.

3.1.7.1.3.3. X.25 Based LAN Interface Hardware

All WIS Workstation (Basic and Target) configurations shall [1] support a hardware interface to the WIS X.25 based Local Area Network (LAN) Interface Unit (IU) which conforms to the physical link,

data link, and CCITT X.25 network link requirements as specified in, and modified by, WIS-ICD-002, **LAN Standard Interface Control Document.** The X.25 network layer software may be implemented in any convenient manner. Examples include X.25 software executed by the WIS Workstation main processor, software downloaded onto an intelligent interface card by the main workstation processor, or as firmware permanently resident on the associated interface system. All X.25 software shall [2] operate correctly under control of the native environment supplied by the WIS Workstations' multitasking operating system (Basic and Target). An application interface library to the X.25 system shall [3] be provided that is compatible with all language translation systems supported by the WIS Workstations, including Ada.

The WIS Workstation's physical link interface to the LAN IU shall [4] transmit and receive data at rates of 1200, 2400, 4800, 9600, and 19200 bits per second (bps), selectable under software control. The WIS Workstation X.25 based LAN hardware interface shall [5] be capable of being upgraded to support a data rate of at least 56000 bps.

The X.25 network layer software shall [6] support packet transfer rates of 80 packets/second when transferring 1024 octet packets. The X.25 network layer software shall [7] be capable of supporting a minimum of eight (8) concurrent X.25 virtual circuits, of which a minimum of four (4) must be permanent virtual circuits (PVC).

3.1.7.1.3.4. IEEE 802.3 LAN Interface Hardware

All WIS Workstation configurations (Basic and Target) shall [1] support a hardware interface that conforms with the requirements of the IEEE 802.3 CSMA/CD networking standards to support IEEE 802.3-compatible communications with the WIS LAN cable system.

The IEEE 802.3 hardware interface shall [2] operate correctly on the following types of distribution cable systems:

a. Broadband coaxial cable as described in IEEE 802.7, with the exception that the coaxial cable systems are to adhere to the delay budget and diameter constraints defined in IEEE 802.3, that the minimum loop loss is assumed to be the loss of that described in 802.7 or 44 dB, whichever is less, and that the maximum loop loss is assumed to be that described in IEEE 802.7 or 56 dB, whichever is greater,

b. Baseband coaxial cable as described in IEEE 802.3 and IEEE 802.3A, and

c. 850 nanometer optical fiber cable having an outer cladding diameter of 125 microns.

Medium attachment units required to attach the IEEE 802.3 workstation hardware interface to the distribution system shall [3] be provided as part of the IEEE 802.3 workstation hardware interface equipment.

The IEEE 802.3 hardware interface shall [4] provide physical link and data link layer protocols in accordance with the requirements of IEEE 802.3 (10Base5), IEEE 802.3A (10Base2), and IEEE 802.3B (10Broad36). Six octet addressing (48 bits) shall [5] be used.

The IEEE 802.3 interface shall [6] support a data rate of no less than ten (10) megabits per second at the transceiver interface to the LAN cable plant.

3.1.7.1.4. Hardware-to-Software External Interfaces

3.1.7.1.4.1. WIS LAN IU Interface Software (GRAY)

The control protocols necessary to establish and maintain data connections and provide multiplexing, flow control, and error recovery over the interface between the WIS Workstation and the X.25 based WIS LAN IU shall [1] be supported by the Basic and Target WIS Workstations. These protocols include the TCP Service Access Protocol (TCP SAP), and the WIS Network Authentication Service (WISNAS). All provisions of the TCP SAP described in WIS-ICD-002 Appendix B shall [2] be provided on all WIS Workstations. All provisions of the WISNAS protocol, as described in WIS-ICD-002 Appendix C, shall [3] be provided. Error messages originating from the SAP LAN interface layer shall [4] be made available to calling applications for processing and display. All TCP SAP and WISNAS software shall [4] execute correctly within the native environment supplied by the WIS Workstations' multi-tasking operating systems. A minimum of eight (8) TCP SAP connections shall [5] be supported by the TCP SAP software.

The TCP SAP and WISNAS software shall [5] operate using the X.25 based LAN Interface hardware described in 3.1.7.1.3.3 (however, see 3.1.7.1.4.2.1).

All TCP SAP and WISNAS software shall [6] execute correctly within the native environment supplied by the WIS Workstation multi-tasking operating systems (Basic and Target). The TCP SAP software shall [7] allow multiple, unrelated tasks to obtain and maintain LAN connections with other WIS LAN-based hosts. An application library package, usable with all language translators including Ada, shall [8] be provided as part of the TCP SAP support software.

3.1.7.1.4.2. TCP/IP Interface Software

The 802.3 LAN Interface Software Interface shall [1] provide internet and transport level communications services in accordance with the requirements contained in the following protocol standards:

MIL-STD-1778,	Transport Control Protocol (TCP);
MIL-STD-1777,	Internet Protocol; and
DDN RFC 792,	Intercomputer Message Protocol (ICMP).

The TCP implementation shall [2] dynamically determine the TCP retransmission timeout value for each connection. The TCP implementation shall [3] allow a segment size of at least 1024 octets. All TCP options as specified in Section 9.3.11, and Security and Precedence as specified in Sections 9.2.10 and 9.2.11 of MIL-STD-1778 shall [4] be supported. Assignment of TCP ports shall [5] be in accordance with RFC 1020, **Internet Numbers,** or its successors. All TCP parameters shall [6] be settable.

The IP implementation shall [7] capable of processing a datagram of at least 576 octets. The following IP options shall [8] be implemented: security, loose source route, strict source route, route record, stream ID, and the IP timestamp. The security options shall [9] be implemented as described in DDN RFC 1038, **Draft Revised Internet Protocol Security Option.** During fragmentation, the following IP options shall [10] be copied to all fragments: security, strict source route, loose source route, and stream ID. The IP "type of service field" shall [11] be mapped to the actual service provided in accordance with RFC 795, **Service Mappings.** IP address fields shall [12] be mapped in accordance with RFC 796, **Address**

Mappings. All WIS Workstations shall [13] be capable of being configured with class A, B, and C addresses. IP broadcast addressing shall [14] be implemented exactly as described in RFC 997, **Internet Numbers.**

The ICMP implementation shall [15] be capable of receiving and acting upon all ICMP message types. The ICMP implementation shall [16] be capable of sending, as a minimum capability, the following message types: Echo Reply, Time Exceeded, Parameter Problem, Timestamp Reply, and Information Reply.

All TCP/IP and related protocol software shall [17] use the IEEE 802.3 hardware interconnection described in 3.1.7.1.3.4 as the hardware interface to the IEEE 802.3 based LAN. IP address to IEEE 802.3 address resolution shall [18] be in accordance with RFC 826, **An Ethernet Address Resolution Protocol.**

The TCP/IP Interface software shall [19] be capable of maintaining no less than 32 concurrent TCP connections. The TCP/IP interface software shall [20] process 1024 octet packets at a rate no less than 90 packets per second on the Basic Workstation, and at a rate no less than 100 packets per second on the Target Workstation. Both workstations shall [21] process one (1) octet packets at rate no less than 120 packets per second. All rates are to be sustained rates.

All TCP/IP interface software shall [22] execute correctly under the native environment supplied by the WIS Workstations' multi-tasking operating systems (Basic and Target). An application program library providing access to TCP/IP services shall [23] be supplied as part of the application development support services software, compatible and usable with all language translators provided as part of the WIS Workstation system.

3.1.7.1.4.2.1. WIS-Unique Protocol Software (GRAY)

The TCP/IP Interface software shall [1] provide the necessary protocols required to assist and participate in the network management functions mediated by the WIS LAN Control Center/Security Monitor (CC/SM). These protocols include Server WISNAS, and the protocols associated with the LAN Access and Control System (LACS). These protocols are described in WIS-SPEC-100, **WIS Local Area Network (LAN) Segment Specification.** This protocol software shall [2] operate correctly within the environment supplied by the WIS Workstations' multi-tasking operating systems (Basic and Target).

An interface library that provides the same application interface as the library supplied to meet the requirements of 3.1.7.1.4.1, **WIS LAN IU Interface Software**, shall [3] be provided to allow application programs access to TCP/IP and WIS-unique protocol software. This library shall [4] be compatible and usable with all language translators supplied as part of the WIS Workstation systems. This library shall [5] operate correctly within the environment supplied by the WIS Workstations' multi-tasking operating systems (Basic and Target)

3.1.7.1.4.2.2. X.25 based Hardware Interface Support (GRAY)

The TCP/IP Interface software shall [1] be capable of using the X.25 based hardware interface described in 3.1.7.1.3.3 to support remote workstations connections via DDN.

3.1.7.1.4.3. GOSIP Transport Level Interface Software (GRAY)

The Government Open Systems Interconnection Profile (GOSIP) Transport Layer Protocol Software System provides a base capability to transfer information between WIS Workstations (Basic and Target) and other WIS hosts (including other WIS Workstations, if specific WIS LAN configurations allow the capability). The GOSIP transport layer protocol software shall [1] conform to the requirements contained in the following International Standards Organization (ISO) standards, as modified by National Bureau of Standards memorandum NBS-IR-87-3674, **Implementation Agreements for Open System Interconnection Protocols:**

ISO Standard 7498,	Basic Reference Model for Open Systems Interconnections;
ISO Standard 8072,	Transport Service Definition; and
ISO Standard 8073,	Connection-Oriented Transport Protocol Specification.

Both Client and Server services shall [2] be supported on all WIS Workstations. An application program interface library that provides access to the transport control protocol layer processing shall [3] be supplied as part of the overall GOSIP transport protocol support. All software shall [4] execute correctly under control of the multi-tasking operating system. All GOSIP protocol software shall [5] be capable of using the IEEE 802.3 LAN Interface hardware system (3.1.7.1.3.4) when supporting communications with other equipment connected to the local LAN. All GOSIP protocol software shall [6] be capable of using the X.25 based LAN hardware interface (3.1.7.1.3.3) for use with remote workstations accessing LAN-based resources via DDN.

3.1.7.1.5. Software-to-Software External Interfaces

3.1.7.1.5.1. WIS Workstation to WWMCCS Host Software Interface

WIS Workstations shall [1] interface to the current WWMCCS ADP equipment (i.e., the Honeywell H6000, DPS-8, DPS-6, DN-8, and Level 6 computer systems) using an emulation of the Honeywell VIP 7705W terminal, as described in Honeywell publication AL29, **Honeywell Data Communication VIP 7700/7705W Manual.** This emulation capability shall [2] function in a manner consistent with a VIP 7705W for all combinations of communications paths with modems, crypto units, land lines, and satellite links inserted between the WWMCCS ADP equipment and the WIS Workstation. This capability shall [3] include support of the auxiliary printer and optional extension monitor interface, RSVP mode, and forms mode. Data transmission shall [4] be controlled by either polling or selecting non-polling protocols, as specified in Honeywell publication AL29. The mode of data transmission shall [5] be block mode, with a maximum of 256 character blocks being permitted in accordance with AL29.

All VIP emulation software shall [6] operate correctly within the environment supplied by the WIS Workstations' multi-tasking operating systems (Basic and Target).

3.1.7.1.5.2. DoD Upper Layer Protocol Software System (GRAY)

The DoD Upper Layer Protocol Software System provides a capability to transfer information, including files or file subsets, between all WIS Workstations (Basic and Target) and other WIS hosts (including other WIS Workstations, if specific WIS LAN configurations allow the capability). The DoD upper layer protocol software shall [1] fully conform to the requirements contained in the following

military standards:

MIL-STD-1780,	File Transfer Protocol (FTP);
MIL-STD-1781,	Simple Mail Transfer Protocol (SMTP); and
MIL-STD-1782,	TELNET.

The SMTP implementation shall [2] conform to the DDN interoperability requirements in RFC 821, **Simple Mail Transfer Protocol,** and to the text message format described in RFC 822, **Standard for the Format of ARPA - Internet Text Messages.** The SMTP service shall [3] support domain names.

The FTP implementation shall [4] provide the minimum configuration outlined in paragraph 5.9.1 of MIL-STD-1780; in addition the commands "password" (PASS), "list" (LIST), "status" (STAT), "help" (HELP), and "passive" (PASV) shall [5] be required to be implemented. The FTP service shall [6] be capable of transferring ASCII and binary files.

The TELNET implementation shall [7] support the following options:

a. Echo,
b. Binary Transmissions,
c. Suppress Go-Ahead,
d. Status,
e. Timing Mark, and
f. Extended Options List.

Implementations of the TELNET options shall [8] be in accordance with the provisions of the appendices contained in MIL-STD-1782.

Both Client and Server TELNET services shall [9] be supported on all WIS Workstations. Client and server FTP services shall [10] be supported for all WIS Workstations. Client and server SMTP services shall [11] be supported on all WIS Workstations. Server implementations shall [12] require, as a minimum capability, the IEEE 802.3 LAN Hardware Interface (3.1.7.1.3.4), and the TCP/IP Interface software (3.1.7.1.4.2). An interface to TELNET, FTP, and SMTP software shall [13] be available through the command language interface of the operating system.

All DoD protocol software shall [14] execute correctly under control of the WIS Workstations' multi-tasking operating systems (Basic and Target). All client protocol software shall [15] be capable of using all WIS LAN communications paths and protocol architectures, as they are developed.

3.1.7.1.5.3. GOSIP Protocol Software System (GRAY)

The Government Open Systems Interconnection Profile (GOSIP) Upper Layer Protocol Software System provides a capability to transfer information, including files or file subsets, between all WIS Workstations (Basic and Target) and other WIS hosts (including other WIS Workstations, if specific WIS LAN configurations allow the capability). The GOSIP protocol software shall [1] conform to the requirements contained in the following International Standards Organization (ISO) standards, as modified by National Bureau of Standards memorandum NBS-IR-87-3674, **Implementation Agreements for**

Open System Interconnection Protocols :

ISO Standard 7498,	Basic Reference Model for Open Systems Interconnections;
ISO Standard 8072,	Transport Service Definition;
ISO Standard 8073,	Connection-Oriented Transport Protocol Specification;
ISO Standard 8473,	Protocol for Providing the Connectionless-Mode Network Service;
ISO DP 8571,	File Transfer, Access Management (FTAM);
ISO DP 9040,	Virtual Terminal Service; and
CCITT X.400,	Message and Mail Handling Protocols.

Both Client and Server services shall [2] be supported on all WIS Workstations. An interface to GOSIP software shall [3] be available through the command language interface of the operating system.

All software shall [4] execute correctly under control of the WIS Workstations' multi-tasking operating system (Basic and Target).

All GOSIP protocol software shall [5] be capable of using the IEEE 802.3 LAN Interface hardware system (3.1.7.1.3.4) when supporting communications with other equipment connected to the local LAN. All GOSIP protocol software shall [6] be capable of using the X.25 based LAN hardware interface (3.1.7.1.3.3) for use on remote workstations accessing LAN-based resources via DDN.

3.1.7.2. Internal Interfaces

This paragraph is not applicable to this specification.

3.1.7.3. Additional Interfaces

3.1.7.3.1. COMSEC Protection (GRAY)

All additional interface controllers supporting the interfaces described in subsequent paragraphs, with the exception of the pointing device interface controller, shall [1] be capable of incorporating and/or using embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the external device and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.1.7.3.2. Serial Ports

A minimum of two serial ports shall [1] be provided on all WIS Workstations (Basic and Target). One of the serial ports shall [2] be an EIA Standard RS-232D port supporting asynchronous serial operations. The other port shall [3] be configurable to support any of the following interfaces:

a. MIL-STD-188C,
b. MIL-STD-188/114 balanced,
c. MIL-STD-188/114 unbalanced,
d. EIA Standard RS-449/422 balanced,
e. EIA Standard RS-449/423 unbalanced, and
f. EIA Standard RS-232D.

The configurable serial port shall [4] provide a 37-pin connector as specified in the EIA RS-449 specification. Adapters shall [5] be supplied to support RS-232D 25 pin DIN connections. The configurable serial ports shall [6] be capable of both synchronous and asynchronous operation.

All serial ports shall [7] be capable of operating at the following speeds: 300, 1200, 2400, 4800, 9600, and 19,200 bits/second.

3.1.7.3.3. Parallel Port Interface

A minimum of one (1) industry standard Centronics parallel interface shall [1] be provided for all WIS Workstations.

3.1.7.3.4. SCSI Port Interface

A Small Computer System Interface (SCSI) port compatible with ANSI X3.131-1986 shall [1] be supported by all WIS Workstation configurations. The SCSI interface shall [2] support a minimum of eight (8) logical devices per port, as defined in the SCSI standard. All required terminators and cables for one (1) external device shall [3] be provided as part of the SCSI interface.

3.1.7.3.4.1 Wide Bus SCSI Interface (GRAY)

The Small Computer System Interface (SCSI) subsystem for all WIS Workstations (Basic and Target) shall [1] be capable of being upgraded and/or replaced by a subsystem meeting the requirements of the SCSI II specification currently under development by the ANSI X3T9.2 sub-committee.

3.1.7.3.5. Pointing Device Interface

A pointing device interface shall [1] be provided for the Basic and Target Workstations for use by the Workstation input pointing devices (3.3.12). Interface support for an input pointing device shall [2] be in addition to the previously defined interfaces. Use of the previously defined interface ports to support the mouse is not allowed.

3.1.8. Government Furnished Property List

This paragraph is not applicable to this specification.

3.2. System Characteristics

3.2.1. Physical Requirements

3.2.1.1. Configuration

No specific requirements exist to define and describe an acceptable physical configuration of WIS Workstation equipment. Desk configured and "tower" configured systems are all acceptable. "Tower" configurations where the system unit sits on the floor and the keyboard and display reside on the desktop are considered adequate as long as the on-desk components fit within the size requirement (3.2.1.2). For all configurations, equipment that facilitates the mounting of the system unit equipment on the floor shall [1] be supplied, including floor mounts, stands, and other such devices, even for devices normally considered as desktop equipment. Equipment that can attach floor-mounted units to a desk or other immovable object shall [2] be provided for ship-based WIS platforms.

3.2.1.2. Size

WIS Workstation components that need to sit on a desktop shall [1] fit within a space not to exceed 22 inches in width and 22 inches in depth. WIS Workstation system units shall [2] be limited to a height of eight (8) inches in height, maximum, if the system is to be capable of being mounted on a desk.

3.2.1.3. Weight

The weight of the any individual component (system unit, display, external disk drives, printers) shall [1] be limited to be a maximum of sixty (60) pounds, except for the printer providing the data processing printer capability.

3.2.1.4. Transportability

The WIS Workstation shall [1] be demountable and movable from one work area to another without requiring the use of special equipment. Protective cases shall [2] be provided for shipping WIS Workstation equipment from one site location to another site. Protective cases shall [3] be supplied for all separable components of the WIS Workstation (system units, displays, printers, external disk drives, etc.). These protective cases shall [4] consist of a hard exterior (metal, hard plastic, etc.) to provide rigid protection against physical abuse, and a cushioned interior to protect the equipment from levels of transmitted damage above those for which the equipment is designed to support. The protective cases shall [5] be of a size and shape that requires no more than two (2) persons to carry the equipment. Handles shall [6] be affixed to the exterior of the case to aid in the portage of the equipment.

3.2.2. Environmental Conditions

3.2.2.1. Operating Environment

All WIS Workstations shall [1] operate correctly, meeting the WIS Workstation reliability requirements contained in 3.4, under the environmental conditions specified below:

a. Temperature: 15° C to 32° C,
b. Altitude: Sea level to 3000 meters,

c. Humidity: 20% to 80% over the entire temperature range, non-condensing, and
d. Air Purity: airborne particles including dust and cigarette smoke will be present in the environment.

3.2.2.2. Non-Operating Environment

All WIS Workstations shall [1] withstand the following environmental conditions that can occur during shipping and storage of the equipment:

a. Temperature: -34° C to 60° C,
b. Altitude: Sea level to 15,000 meters, and
c. Humidity: 20% to 80% over the entire non-operating temperature range, non-condensing.

3.2.2.3. Power

All WIS Workstations and related equipment requiring power shall [1] support both of the following voltages and line frequency combinations:

a. 115V +/- 10V at 60/50 Hz single phase,
b. 220V +/- 20V at 60/50 Hz single phase.

Workstation equipment shall [2] contain power supplies that can support both voltage/frequency combinations within a single unit, as well as power supplies that support only combination (a), above. Access to either voltage/frequency combination in dual mode configurations shall [3] be provided via an externally-accessible switch, as a minimum capability.

Necessary fluctuating transient and line voltage protection shall [4] be provided. The power supplies shall [5] be marked with the applicable safe operating voltage ranges.

All WIS Workstation equipment shall [6] support the use of power cable connectors compatible with the power outlet configurations at all WIS sites. Appendix VI lists the required power connection configurations to be supported. The power cable shall [7] be removable and changeable without requiring access to the interior of the equipment, to facilitate movement of the equipment site location to site location.

All power equipment and cables, including power cords, shall [8] be certified under the certification programs of the Underwriter's Laboratory (UL).

3.2.2.4. Electrical Grounding

All WIS Workstations and associated peripheral equipment shall [1] conform to the grounding requirements contained in the National Electric Code (NEC-1984).

3.2.2.5. Noise Limits

Total WIS Workstation noise from collocated workstation equipment (computers, printers, etc.) shall [1] be a maximum of 60 dBA, in accordance with the requirements of MIL-STD-1472. The noise levels shall [2] be attained without requiring the use of acoustic enclosures or other external muffling devices.

3.2.3. Nuclear Control Requirements

This paragraph is not applicable to this specification.

3.2.4. Materials, Processes, and Parts

The WIS Workstation hardware and software shall [1] meet all of the requirements described in this specification and be based on Proven Non-Developmental Items (NDI) hardware and software. The term "Proven Non-Developmental Item", (NDI), is defined as **a hardware or software item that has been produced by a contractor and is available for sale, that requires no additional design or development to meet required specifications, and which has meaningful performance, reliability, supportability and maintenance data proven by substantial use. Substantial use includes (1) typically 100,000 combined hours of use of several items or instances of items, (2) at performance comparable to that specified, (3) with verifiable failure and repair records, and (4) with maintenance procedures, test equipment, and replacement units, repair turnaround times, and an established support structure which are comparable to the specified maintenance concept.**

All hardware products used to satisfy the TEMPEST requirements contained in this specification shall [2] be compatible in operation with the commercial version of those products.

3.2.4.1. Environmental Stress Screening (ESS)

In order to remove latent defects (parts, materials, workmanship, etc.) prior to delivery, all workstation associated equipment and systems shall [1] undergo manufacturing screening as part of the production process. The screening process shall [2] be a government-approved, contractor standard in-house process for this purpose, or, if no process is implemented, the environmental stress screening method defined in Table I, or, a contractor-proposed and government-approved variation on the method defined in Table I.

3.2.5. Electromagnetic Radiation

All WIS Workstation equipment and peripherals described in this Specification shall [1] be provided in TEMPEST and non-TEMPEST configurations. All TEMPEST-certified workstation components shall [2] be tested and certified that the equipment complies with all requirements of NACSIM 5100A. All non-TEMPEST components shall [3] be tested in accordance with the testing requirements of NACSIM 5100A. WIS Workstations shall [4] comply with all requirements of NACSIM 5201. WIS Workstations shall [5] comply with all requirements of NACSIM 5203.

All non-TEMPEST WIS Workstations and associated peripheral equipment shall [6] conform to the requirements of the Radio Frequency Interference (RFI) standards contained in the U.S. Federal Communications Commission (FCC) Class B regulations.

3.2.6. Workmanship

All WIS Workstation and associated peripheral equipment shall [1] be constructed to ensure reliable operation and safety. All items shall [2] be free of defects that would interfere with operational and/or developmental use.

TABLE I

Environmental Stress Screening Requirements

THERMAL CYCLING (see note 6)	PC Board	Equipment Box Drawer	System or Prime Item
Temperature Dwell Range	-34° to +60° C	-34° to +60° C	-34° to +60° C
Temperature Rate of Change	30 deg. C/min Chamber Air Temp	10 deg. c/min Chamber Air Temp	5 deg. c/min Chamber Air Temp
Temperature Cycles	25	10	5
Temperature Dwell Duration	See Note 1	See Note 1	See Note 1
Equipment Operation	See Note 2	See Note 2	See Note 2
Equipment Monitoring	See Note 3	See Note 3	See Note 3
VIBRATION (see note 5)			
Type	Random or Pseudo Random	Random or Pseudo Random	Not Applicable
Power Spectral Density	0.045 g2/HZ (avg) 20 - 2000 HZ	0.045 g2/HZ (avg) 20 - 2000 HZ	
Axes Stimulated Sequentially or Simultaneously	3 Axes	3 Axes	
Duration of Vibration	10 min./axis	10 min./axis	
Equipment Operation	See Note 2	See Note 2	
Equipment Monitoring	See Note 3	See Note 3	

1) The next temperature ramp can commence as soon as the temperature has stabilized (i.e., when the temperature of the part of the test item considered to have the longest thermal lag is changing no more than 2°C per hour).
2) Screened assemblies shall be operating during temperature rise and vibration and off during the temperature drop. Operating equipment shall be at maximum power loading. Power will be turned on and off a minimum of three times at the temperature extremes of each cycle
3) Instantaneous GO-NOGO performance monitoring during the stress screen is essential to identify intermittent failures. If such monitoring cannot be performed for one level of assembly, ESS will be performed on the next higher level of assembly, but using the ESS specifications for the lower level assembly.
4) Use of temperature chambers which will provide the temperature rate of change is desired. However, rapid transfers of the equipment between one chamber at maximum temperature and another chamber at minimum temperature is acceptable.
5) Simultaneous vibration and temperature stress screening is desired but not required. When temperature and vibration are applied separately, it is recommended that vibration occur first.
6) At least five of the required temperature cycles will be performed after the random vibration portion of this screen. The last temperature cycle will be failure free.

3.2.7. Interchangeability

Components procured as part of the WIS Workstation segment which perform similar or identical functions shall [1] be interchangeable in accordance with requirement 7 of MIL-STD-454K.

3.2.8. Safety

All WIS Workstations and associated peripheral equipment shall [1] contain safety features which achieve a hazard risk area not to exceed 1D, 2D, 3C, and 4B as specified in MIL-STD-882B. All WIS Workstations and associated peripheral equipment shall [2] conform to ANSI/UL standard 478-1979, "Safety Standard for Electronic Data Processing Units and Systems." Proper warning labels and placards shall [3] be provided wherever there exists a potential hazard to personnel.

3.2.9. Human Performance/Human Engineering

Anthropometric and user interface requirements contained in MIL-STD-1472C shall [1] be applied to all WIS Workstation hardware and software components. MIL-STD-1472C shall [2] be part of the selection criteria for the workstation. Any new work in hardware or software shall [3] conform to the requirements of MIL-STD-1472C and **USI Guidelines**, ESD-TR-86-278.

3.2.10. Deployment Requirements

WIS Workstations and peripheral equipment shall [1] be deployed to WIS locations worldwide.

3.2.11. System Effectiveness Models

This paragraph is not applicable to this specification.

3.2.12. Nameplates and Markings

All WIS Workstation equipment shall [1] be identified by the nameplate and product markings provided as part of normal commercial practice. Universal Product Code (UPC) markings shall [2] be affixed to all detachable components for use with automated inventory control methodologies. Storage and shipping markings shall [3] be affixed and designed in accordance with the requirements of MIL-STD-129J.

3.2.13. Performance

All WIS Workstation systems will be required to execute a series of government-supplied benchmark software with the same or better performance as the measurements contained in Table II. Systems supplied to meet the requirements of the the Basic Workstation (see 3.3.1) shall [1] meet or exceed the performance levels contained in column 1 of Table II. Systems supplied to meet the requirements of the Target Workstation shall [2] meet or exceed the performance levels contained in column 2 of Table II. Appendix IV describes the systems used by the government to obtain the various performance levels listed in Table II.

TABLE II

Performance
Requirements

Performance Tests	Minimum Levels Basic Workstation	Minimum Levels Target Workstation	Units	
Whetstone Timing	120.0	350.0	KWIPS	
Dhrystone Timing	470.0	1600.0	Dhry/sec	
Henessey Timings				
- Queens	5.5	1.0	sec.	(a)
- Tower	7.5	2.0	sec.	(a)
- FFT	13.0	3.5	sec.	(a)
- Bubble Sort	15.0	3.0	sec.	(a)
- Binary Search (QUICK)	6.0	1.0	sec.	(a)
- Matrix Multiply (integer)	8.0	2.0	sec.	(a)
- Matrix Multiply (float)	10.0	3.0	sec.	(a)
- Tree	4.5	1.0	sec.	(a)
- Ackermann Function	61.5	15.0	sec.	(a)
- Permutation Test	8.0	2.0	sec.	(a)
- Puzzle	63.0	13.0	sec.	(a)
Disk I/O Tests				
- Sequential Read 128 Bytes	5.0	5.0	millisec.	(b)
- Sequential Read 256 Bytes	10.0	10.0	millisec.	(b)
- Sequential Read 512 Bytes	20.0	20.0	millisec.	(b)
- Sequential Read 1024 Bytes	23.0	23.0	millisec.	(b)
- Sequential Read 2048 Bytes	29.0	29.0	millisec.	(b)
- Sequential Read 4096 Bytes	42.0	42.0	millisec.	(b)
- Sequential Read 16384 Bytes	117.0	117.0	millisec.	(b)
- Sequential Write 128 Bytes	10.0	10.0	millisec.	(b)
- Sequential Write 256 Bytes	19.0	19.0	millisec.	(b)
- Sequential Write 512 Bytes	36.0	36.0	millisec.	(b)
- Sequential Write 1024 Bytes	40.0	40.0	millisec.	(b)
- Sequential Write 2048 Bytes	48.0	48.0	millisec.	(b)
Sequential Write 4096 Bytes	77.0	77.0	millisec.	(b)
- Sequential Write 16384 Bytes	230.0	230.0	millisec.	(b)
- Random Access (200 records/256 bytes)	85.0	50.0	millisec.	(b)
- Append Updates (100 records/256 bytes)	20.0	20.0	millisec.	(b)
- Random Updates (200 records/256 bytes)	120.0	85.0	millisec.	(b)
- Random Access (200 records/1024 bytes)	85.0	55.0	millisec.	(b)
- Append Updates (100 records/1024 bytes)	40.0	40.0	millisec.	(b)
- Random Updates (200 records/1024 bytes)	120.0	70.0	millisec.	(b)
- Random Access (200 records/1011 bytes)	120.0	80.0	millisec.	(b)
- Append Updates (100 records/1011 bytes)	75.0	75.0	millisec.	(b)
- Random Updates (200 records/1011 bytes)	200.0	160.0	millisec.	(b)

(a) CPU Time measurements
(b) Wall Clock Time measurements

3 3. Processing Resources

Requirements for the hardware and software associated with the WIS Workstation Segment are presented herein. The hardware components of the Workstation computer systems described include:

a. The Basic Workstation, and
b. The Target Workstation.

These systems include peripherals such as disk systems, displays, and keyboards which are described in separate, self-contained sections of this paragraph. Tables III-V provide summaries of the salient requirements for the WIS Workstation systems.

Conditions on the software requirements described in 3.1.4 specific to each of WIS Workstation computer systems are also described in this paragraph.

Associated WIS Workstation peripheral equipment described in this specification include:

a. The Alphanumeric Printer,
b. The Color Graphics Printer,
c. The Page-Oriented Printer,
d. The Remote Line Printer,
d. The Printer Sharing System,
e. Input Pointing Devices, and
f. The High Quality Graphics Device.

Table VI provides a summary of the salient requirements for the printers. Table VII summarizes the characteristics of the two printer sharing systems contained in the specification. Table VIII describes the minimum workstation configuration for use in determing power supply suitability and other related requirements defined in this section.

The product descriptions contained herein are requirements for capabilities . Mapping of hardware and system software capabilities described in this specification to actual implementations will be determined by the WIS Workstation procurement and acquisition process.

3.3.1. Basic Workstation Computer System

The capabilities required of the Basic WIS Workstation are described in this paragraph of the WIS Workstation Segment Specification. The Basic Workstation is designed to support initial development of compute-intensive workstation applications, as well as provide support for Block A and early Block B WIS Workstation applications such as the AMH and initial JOPES applications. The Basic Workstation is intended to provide a lower cost alternative to those members of the WIS community who do not need the advanced processing capabilities of the Target Workstation, and do not want to expend the extra funds to obtain workstation functionality.

TABLE III

Summary of Nominal Workstation Configurations

Processing Resources	Basic Workstation	Target Workstation
On-board Memory Memory Expansion	4 MB extended minimum 16 MB	8 MB extended minimum 16 MB
Memory Data Bus Width	minimum 16 bits	minimum 32 bits
System I/O Bus Width	minimum 16 bits	minimum 16 bits
Accessible Operand Widths	8 & 16 & 32 bits	8 & 16 & 32 bits
Character Set (128 ASCII)	yes	yes
Basic Clock Speed	8 MHz minimum	16 MHz minimum
Memory Bus Speed	4 megawords/sec	10 megawords/sec
System I/O Bus Speed	1 megawords/sec	3 megawords/sec
Large Capacity Storage System	1 - 40 MB removable 1-40 MB lockable support additional controller	1 - 40 MB removable 1-40 MB lockable support additional controller
Large Capacity Storage Growth	80,160,240 MB	80,160,240 MB
3.5" Floppy Drive	required	required
Backplane Expansion Slots	3	3
Keyboard	ANSI/101-key 128 ASCII chars 12 PFK	ANSI/101-key 128 ASCII chars 12 PFK
Video Displays (default)	Color Graphics 640x480 16/64 colors 25 lines x 80 chr 12" screen	Color Graphics 1024x768 256/4096 colors 25 lines x 80 chr 14" screen
Pointing Device (mouse/trackball)	yes	yes

TABLE IV

Workstation Interfaces

Interface	Basic Workstation	Target Workstation
1 - [illegible]ywell Synch. Serial Port	Option	Option
1 - Block A LAN X.25 Port	Option (Note 1)	Option (Note 1)
1 - IEEE 802.3 CD/CSMA Port	Option (Note 1)	Option (Note 1)
1 - Parallel Port	Required	Required
1 - RS-232D Serial Port	Required	Required
1 - Configurable Serial Port	Required	Required
1 - SCSI Port	Required	Required
1 - RS-170A Aux. Video Port	Low Resolution Display	Low Resolution Display
1 - Auxiliary Video Port	Med/High Resolution Displays	Med/High Resolution Displays

Note 1: Either the X.25 or the 802.3 Interface can be included as the LAN interface; however at least one is mandatory.

TABLE V

Workstation Expansion Options

Option	Basic Workstation	Target Workstation
4 MB Memory Upgrade	X	X
5.25" Floppy Disk Drive	X	X
19" Color Monitor	X	X
14" Color Monitor	X	
12" Color Monitor		X
1280x1024 Video Card	X	X
1024x768 Video Card	X	
640x480 Video Card		X
Large Capacity Storage Backup	X	X
Storage Expansion Units	80, 160, 240 MB units	80, 160, 240 MB units

TABLE VI

Summary of Workstation
Printer Characteristics

Attribute	Alphanumeric Printer	Color Graphics Printer	Page-Oriented Printer	Data Processing Printer
Word Size	7 or 8 bits	7 or 8 bits	7 or 8 bits	7 or 8 bits
Paper	8 1/2 x 11 8 1/2 x 14 14 1/2 x 11 Office quality bond	8 1/2 x 11 8 1/2 x 14 14 1/2 x 11 Office quality bond Transparencies	8 1/2 x 11 8 1/2 x 14 Office quality bond Transparencies	8 1/2 x 11 14 7/8 x 11 Computer Bond fanfold
Print Speeds	LQ: 35 char/sec	Draft: 200 char/sec NLQ: 65 char/sec LQ: 35 chars/sec	5 pages/min Postscript Diablo 630 emulation	600 lprn (min.)
Interfaces	see 3.1.7.3	see 3.1.7.3	see 3.1.7.3	see 3.1.7.3
Graphics	no	150 dpi x 80 dpi	300 dpi x 300 dpi	no
Color	no	yes	no	no
Fonts	OCR Fonts 4 additional	OCR Fonts 4 additional	OCR Fonts 4 additional	no requirements

TABLE VII

Printer Sharing Systems

	Low Capacity	High Capacity
No. of W/S	5	20
No. of Printers	1	4
Switch Mechanism	Electronic	Electronic
Buffering	required	required

TABLE VIII

Summary of Minimum Workstation Configurations
- For Power Supply Consideration -

Processing Resources	Basic Workstation	Target Workstation
On-board Memory	4 MB extended	8 MB extended
Memory Data Bus Width	minimum 16 bits	minimum 32 bits
System I/O Bus Width	minimum 16 bits	minimum 16 bits
Accessible Operand Widths	8 & 16 & 32 bits	8 & 16 & 32 bits
Character Set (128 ASCII)	yes	yes
Basic Clock Speed	8 MHz minimum	16 MHz minimum
Memory Bus Speed	4 megawords/sec	10 megawords/sec
System I/O Bus Speed	1 megawords/sec	3 megawords/sec
Large Capacity Storage System	1 - 40 MB removable 1-40 MB lockable	1 - 40 MB removable 1-40 MB lockable
3.5" Floppy Drive	yes	yes
Backplane Expansion Slots	3	3
Keyboard	yes	yes
Video Displays (default)	Low Resolution 640x480	Medium Resolution 1024x768
Pointing Device (mouse/trackball)	yes	yes
Interfaces	LAN Interface Configurable Serial Port Aux. Video Port Parallel Port RS-232 Serial Port SCSI Port	LAN Interface Configurable Serial Port Aux. Video Port Parallel Port RS-232 Serial Port SCSI Port

It is intended that this Basic Workstation be totally upwardly compatible with the Target Workstation so that application development efforts need deal with only one environment, and that end-users can transfer acquired knowledge from one environment to the other.

Usage of this workstation is intended to be within a System High, Limited Multi-Level Secure, or Multi-Level Secure security environment.

3.3.1.1. Basic Workstation Computer Hardware Requirements

The Basic WIS Workstation includes seven hardware elements to which requirements are allocated in a manner that meets the physical and functional requirements of this specification. These elements include:

a. Display,
b. Keyboard,
c. Processor,
d. Primary Memory,
e. Auxiliary Storage,
f. System back plane or bus, and
g. Interfaces.

Requirements on these components of the Basic Workstation are defined in the following sub-paragraphs.

3.3.1.1.1. Basic Workstation Memory

The Basic Workstation shall [1] contain a minimum of four (4) megabytes of memory that is directly addressable by the WIS Workstation processor. The Basic Workstation system architecture shall [2] be capable of being expanded to include a minimum of sixteen (16) megabytes of directly addressable memory within the workstation system unit.

3.3.1.1.2. Basic Workstation Word Size

The Basic WIS Workstation processor, and memory subsystem bus shall [1] support a minimum of sixteen (16) data bits as the memory word size. The Basic WIS Workstation system I/O bus shall [2] contain, as a minimum capability, a mixture of sixteen (16) data bits and eight (8) data bits, depending on the location of the connection card, as the system I/O data bus word size. A maximum capability would be if all card locations supported the 16-bit word size. The Basic WIS Workstation processor instruction set shall [3] be capable of accessing and processing 8-bit, 16-bit, and 32-bit data quantities.

3.3.1.1.3. Basic Workstation Character Set Standards

The Basic Workstation shall [1] support the entire 128-character ASCII character set as defined in FIPS Publication 1-2.

3.3.1.1.4. Basic Workstation Instruction Set Architecture

No special requirements exist for the Basic Workstation processor instruction set architecture.

3.3.1.1.5. Basic Workstation Interrupt Capabilities

No specific requirements exist for interrupts beyond those implemented as part of standard commercial practice.

3.3.1.1.6. Basic Workstation Direct Memory Access Capabilities

No special requirements for Basic Workstation Direct Memory Access (DMA) support exist outside of standard commercial practices.

3.3.1.1.7. Basic Workstation Processing Speed

The Basic Workstation processor clock shall [1] support a minimum clock rate of 8 MHz +/- 5%. The Basic Workstation memory subsystem shall [2] be capable of supporting this clock rate with a maximum of one (1) wait state for memory accesses.

3.3.1.1.8. Basic Workstation Process Isolation Support

The processor within the Basic Workstation shall [1] supply hardware support for the concepts of process isolation, process-based memory/instruction privileges, and memory protection. The processor hardware shall [2] support the concepts of a "supervisor" state and a "user" state, as a minimum, where the supervisor state has more privileges with regard to instructions that can be executed, and memory that can be accessed than the user state. The hardware shall [3] enforce a policy of controlled access to privileged system resources (e.g., instructions, memory, interrupts, etc.) by less privileged processes through the use of illegal instruction traps, access violation faults, or other similar mechanisms that allow the operating system to intercept privilege protection violations and take action upon that violation. The Basic Workstation processor shall [4] provide hardware capabilities to support the concept of virtual memory and provide memory protection from contamination by other active concurrently executing processes.

3.3.1.1.9. Basic Workstation Numeric Processor

The numerical processing capabilities of the Basic WIS Workstation shall [1] consist of the following operations, as a minimum:

a. Addition,
b. Subtraction,
c. Multiplication,
d. Division,
e. Conversion to integer (fixed point),
f. Conversion from integer (fixed point),
g. Conversion from single precision to double precision, and
h. Conversion from double precision to single precision.

Hardware support for the standard mathematical functions such as roots, trigonometric, hyperbolic, logarithmic, and exponential functions shall [2] be supplied as well. All operators shall [3] operate on

single precision and double precision floating point operands that conform to the IEEE 754 Floating Point Standard.

The numerical processor shall [4] provide hardware assistance to combat round-off error propagation, including features such as guard bits on internal processor registers, rounding when converting to memory formats, appropriate normalization techniques when normalizing mantissas and other standard techniques.

The numerical processing capabilities of the Basic WIS Workstation may be supplied as either a separate co-processor within the Basic Workstation system unit, or as an inherent component of the Basic Workstation processor instruction set. If supplied as a separate co-processor unit, the numerical co-processor shall [5] support the same clock speed requirements stated for the main Basic Workstation processor in 3.3.1.1.7.

3.3.1.1.10. Basic Workstation Bus Architecture

The Basic WIS Workstation shall [1] be constructed from a basic set of logic modules or cards which are interconnected by insertion into connectors mounted on the system unit's back plane or bus(ses). The full set of system bus signal lines (including the 16 data lines) shall [2] be present at more than half the number of connector locations, and shall [3] be present in the bus connector for use by any inserted cards. The remaining locations may have fewer data lines; however, all bus control and address lines shall [4] be present at these connectors as well. Connector locations that are destined to contain system memory shall [5] be full function locations with a full set of data bus signal lines. The back plane shall [6] be of a design that has been placed in the public domain, is derived from accepted industry/government standards, and/or is available for licensing from a vendor.

The Basic WIS Workstation configurations shall [7] provide a minimum of three (3) system back plane slots in excess of those slots required for supporting the minimum Basic Workstation system configuration as outlined in Table IV, two of which must be full function slots.

3.3.1.1.11. Basic Work tation Backplane Data Rate Requirements

The Basic WIS Workstation shall [1] sustain a minimum data transfer rate between the workstation processor and main memory system of four (4) megawords/sec, where a word is defined to be the length of the data bus component of the memory system bus structure. The Basic WIS Workstation shall [2] sustain a minimum of one (1) megaword/sec over the system input/output (I/O) bus to and from peripheral controller devices.

3.3.1.1.12. Basic Workstation Clock and Calendar

A time-of-day clock and calendar function shall [1] be provided in the Basic Workstation design. The clock shall [2] provide a indication of the time-of-day that can be accessed by user commands issued via the multi-tasking operating system, and by application software. The calendar shall [3] provide an indication of the calendar date (year, month, day) that can be accessed by user commands issued via the multi tasking operating system, and by application software. The calendar shall [4] provide adjustments based on leap year calculations. Both the clock and calendar shall [5] be provided with battery backup to maintain the timekeeping functions while the workstation is powered down. The battery back-up shall [6] be capable of disconnection for declassification purposes. The battery backup shall [7] provide backup

power for the clock/calendar system only. The battery shall [8] be readily available in the commercial marketplace, worldwide. Software to set and examine both the clock and calendar data shall [9] be provided for use with the multi-tasking operating system.

3.3.1.1.13. Basic Workstation Power Supply

The Basic WIS Workstation power supply shall [1] be of adequate size to provide sufficient power for all included cards and peripheral equipment carried in the system unit, as well as providing a 20% reserve power for additional cards and equipment. The reserve shall [2] be measured on a minimum configuration as defined in Table VIII, with all open slots filled with sufficient memory cards or modules to bring the system memory size to the maximum amount allowed (16 megabytes minimum, or "best bid").

3.3.1.1.14. Basic Workstation Display Capabilities

The Basic Workstation shall [1] provide, as part of the nominal configuration, a display monitor that meets the requirements of the Small Screen monitor (3.3.3.2.2). The Basic Workstation shall [2] provide, as part of the nominal configuration, a video processing capability that meets the requirements of the Low Resolution video processing capability, as described in 3.3.3.1.1. The Basic Workstation shall [3] be capable of using any of the video systems described in 3.3.3.

3.3.1.1.15. Basic Workstation Audio Output

The Basic WIS Workstation shall [1] provide an audio output subsystem. The Basic WIS Workstation audio output subsystem shall [2] provide the capability to allow application programs to control the pitch (frequency and time characteristics), duration, and volume of the tones emitted by the output device.

3.3.1.1.16. Basic Workstation Diagnostic Capabilities

The Basic WIS Workstation shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for diagnosis of hardware faults (i.e., go/nogo, pass/fail types of tests).

3.3.1.1.17. Basic Workstation Growth Capabilities

The system architecture of the Basic Workstation shall [1] be such that the Basic Workstation can be transformed into a system that meets the requirements of the Target WIS Workstation (3.3.2), with appropriate changes to the supplied processing cards and/or system back plane. All operating systems, system utilities, development support, and application software shall [2] be upwardly compatible with the equivalent Target Workstation capabilities.

3.3.1.2. Basic Workstation Computer Software Requirements

Conditions on the requirements for the software described in 3.1.4 that are specific to the Basic Workstation are contained in this paragraph. No known conflicts exist between the requirements stated in this paragraph, or in 3.1.4; however, if a conflict is discovered, the requirements in this section shall [1] take precedence over the requirements contained in 3.1.4.

3.3.1.2.1. Basic Workstation Operating System Software

A multi-tasking operating system is required to be supplied with the Basic Workstation. The Basic Workstation shall [1] be capable of executing correctly a multi-tasking operating system that meets the requirements of 3.1.4.2.1.

Initialization processing shall [2] take no longer than five (5) minutes on the Basic Workstation when the associated disk system is 80% full, and file system checking is enabled on startup. Initialization processing shall [3] take no longer than three (3) minutes on the Basic Workstation when file system checking is disabled on startup. Shutdown processing shall [4] take no longer than three (3) minutes to complete on the Basic Workstation when performing basic shutdown activities (i.e, not including either LAN closeout software, or user/site designated processing). The shutdown processing times shall [5] include file system integrity checking, if enabled.

3.3.1.2.2. Basic Workstation Language Translator Systems

An Ada development environment is required for development of WIS applications for the Basic Workstation. The Basic Workstation Ada development system shall [1] meet the requirements contained in 3.1.4.2.2 of this Specification. The Ada development system shall [2] produce Basic Workstation native machine code usable with the Basic Workstation multi-tasking operating system, and other application development support software packages defined in 3.1.4.2. The Ada development system shall [3] be hosted either on the Basic WIS Workstation, or on the Target WIS Workstation and code produced for the Basic Workstation via cross-compilation techniques.

Instances of all other compilers described in 3.1.4.2.2 shall [4] exist for use with the Basic Workstation, and shall [5] execute correctly on the Basic WIS Workstation. All non-Ada compilers shall [6] produce native machine code for the Basic WIS Workstation, and shall [7] be operate under control of and be compatible with the multi-tasking operating system, and all application development support software packages that exist on the workstation.

3.3.1.2.3. Basic Workstation Program Development Services Software

The Basic Workstation is required to host versions of the programming support software packages described in 3.1.4.2.3. The Basic Workstation applications development software packages shall [1] be compatible with the Basic Workstation Ada compilation system described in 3.3.1.2.2, and shall [2] execute correctly in conjunction with the Basic Workstation multi-tasking operating system described in 3.3.1.2.1.

3.3.1.2.4. Basic Workstation User Services Software

Software implementing the functions and capabilities of the user services software described in 3.1.4.3 is required for use with the Basic WIS Workstation. Each related set of capabilities described in 3.1.4.3 (word processor, spreadsheet, etc.) shall [1] be capable of executing as a standalone program within the environment of the Basic WIS Workstation.

Software which integrates a subset of the functions described in 3.1.4.3 is required for use with the Basic WIS Workstation. The Basic Workstation shall [2] be capable of executing correctly an

integrated software suite whose individual components meet the requirements of the following User Services capabilities described in 3.1.4.3:

a. Word Processing (3.1.4.3.3),
b. Spreadsheet (3.1.4.3.4),
c. Database Management (3.1.4.3.5), and
d. Basic Graphics (3.1.4.3.6.1 and 3.1.4.3.6.2).

An integrated software suite is a software environment which consists of functional modules that have been created to work together as an integrated system. Characteristics that indicate the degree of integration include:

a. Consistency of the user interface across different functional modules,
b. Capabilities to pass and incorporate data from one module to the next, and
c. Ability to move between various modules.

Integration of the required functions can occur through the use of a monolithic software package, or through the use and enforcement of a standardized environment (such as an operating system) that provides the integration function.

The Basic Workstation shall [3] be capable of executing correctly a software suite that implements a VT-240 terminal emulation capability meeting the requirements of 3.1.4.3.7.

All Basic WIS Workstation user services software shall [4] execute within, and under the control of the native environment supplied by the Basic Workstation multi-tasking operating system described in 3.3.1.2.1.

3.3.1.2.5. Basic Workstation MS-DOS Software Support

The Basic WIS Workstation shall [1] maintain an environment that provides for the correct execution of the selected MS-DOS software described in 3.1.4.2.1.15. The Basic WIS Workstation multi-tasking operating system shall [2] provide this environment as a sub-task within overall control of the multi-tasking operating system. A minimum of one (1) MS-DOS environment emulation task shall [3] be provided by the Basic WIS Workstation multi-tasking operating system.

3.3.2. Target Workstation Computer System

The capabilities required of the Target WIS Workstation are described in this paragraph of the WIS Workstation Segment Specification. The Target Workstation is designed to support development and use of compute-intensive workstation applications and provide support for Block A and target Block B WIS Workstation applications. The Target WIS Workstation is designed to support the planning and operations community who require a high-performance compute platform to support current and envisioned WIS applications.

Usage of this workstation is intended to be within a System High, Limited Multi-Level Secure, or Multi-Level Secure security environment.

3.3.2.1. Target Workstation Computer Hardware Requirements

The Target WIS Workstation includes seven hardware elements to which requirements are allocated in a manner that meets the physical and functional requirements of this specification. These elements include:

a. Display,
b. Keyboard,
c. Processor,
d. Primary Memory,
e. Auxiliary Storage,
f. System backplane or bus, and
g. Interfaces.

The following sub-paragraphs contain the requirements for the various components of the Target WIS Workstation.

3.3.2.1.1. Target Workstation Memory

The Target WIS Workstation shall [1] contain a minimum of eight (8) megabytes of memory that is directly addressable by the WIS Workstation processor. The Target Workstation system architecture shall [2] be capable of being expanded to include a minimum of sixteen (16) megabytes of directly addressable memory within the workstation system unit.

3.3.2.1.2. Target Workstation Word Size

The Target WIS Workstation processor and memory subsystem shall [1] provide a minimum of thirty-two (32) physical data bits for the memory word size. The system I/O bus of the Target Workstation shall [2] provide, as a minimum capability, sixteen (16) physical data bits to a majority of connector locations on the bus, and a minimum of eight (8) data bits to the remainder of the connector locations. The full set of control and address lines shall [3] be present at every connector location on the system. I/O bus. The Target WIS Workstation processor shall [4] be able to access and process 8-bit, 16-

bit. and 32-bit data quantities over the memory bus within the workstation system. The Target WIS Workstation processor shall [5] be able to access and process a minimum of 8-bit and 16-bit data quantities over the system I/O bus within the workstation system.

3.3.2.1.3. Target Workstation Character Set Standards

The Target Workstation shall [1] support the entire 128-character ASCII character set as defined in FIPS Publication 1-2.

3.3.2.1.4. Target Workstation Instruction Set Architecture

No special requirements for the Target Workstation processor instruction set architecture exist outside of standard commercial practices.

3.3.2.1.5. Target Workstation Interrupt Capabilities

No special requirements for interrupts exist beyond those found as part of standard commercial practices.

3.3.2.1.6. Target Workstation Direct Memory Access Capabilities

No special requirements exist for Direct Memory Access (DMA) capabilities for the Target WIS Workstation beyond standard commercial practice.

3.3.2.1.7. Target Workstation Processing Speed

The Target Workstation processor clock shall [1] support a minimum clock rate of 16 MHz +/- 5%. The Target Workstation memory subsystem shall [2] support this clock rate with zero (0) wait state performance 98% of the time. For cache-based memory system designs, this requirement is equivalent to a cache hit rate of 98% for zero-wait state compatible memory within the cache component.

3.3.2.1.8. Target Workstation Process Isolation Support

The processor within the Target Workstation shall [1] supply hardware support for the concepts of process isolation, process-based memory/instruction privileges, and memory protection. The processor hardware shall [2] support the concepts of a "supervisor" state and a "user" state, as a minimum, where the supervisor state has more privileges with regard to instructions that can be executed, and memory that can be accessed than the user state. The hardware shall [3] enforce a policy of controlled access to privileged system resources (e.g., instructions, memory, interrupts, etc.) by less privileged processes through the use of illegal instruction traps, access violation faults, or other similar mechanisms that allow the operating system to intercept privilege protection violations and take action upon that violation. The Target Workstation processor shall [4] provide hardware capabilities to support the concept of virtual memory and provide memory protection from contamination by other active concurrently executing processes.

3.3.2.1.9. Target Workstation Numeric Processor

The numerical processing capabilities of the Target WIS Workstation shall [1] consist of the following operations, as a minimum:

a. Addition,
b. Subtraction,
c. Multiplication,
d. Division,
e. Conversion to integer (fixed point),
f. Conversion from integer (fixed point),
g. Conversion from single precision to double precision, and
h. Conversion from double precision to single precision.

Hardware support for the standard mathematical functions such as roots, trigonometric, hyperbolic, logarithmic, and exponential functions shall [2] be supplied as well. All operators shall [3] operate on single precision and double precision floating point operands that conform to the IEEE 754 Floating Point Standard.

The numerical processor shall [4] provide hardware assistance to combat round-off error propagation, including features such as guard bits on internal processor registers, rounding when converting to memory formats, appropriate normalization techniques when normalizing mantissas and other standard techniques.

The numerical processing capabilities of the Target WIS Workstation may be supplied as either a separate co-processor within the Target Workstation system unit, or as an inherent component of the Target Workstation processor instruction set. If supplied as a separate co-processor unit, the numerical co-processor shall [5] support the same clock speed requirements stated for the main Target Workstation processor in 3.3.2.1.7.1.

3.3.2.1.10. Target Workstation Bus Architecture

The Target WIS Workstation shall [1] be constructed from a basic set of logic modules or cards which are interconnected by insertion into connectors mounted on the system unit's bus(ses). Multiple bus structures may be used in the architecture of the Target Workstation; for example, the memory subsystem bus may be separate from the I/O subsystem bus. If multiple bus structures are used in the Target Workstation architecture, all registers and memory locations shall [2] be directly accessible by the workstation processor. The full set of signal lines present in the system I/O bus, or system bus, if one bus structure is used, shall [3] be present at least 75% of the connector locations. All bus signal lines shall [4] be present at the memory bus card locations. All signal lines at each location on all busses shall [5] be available through the card connector for use by inserted cards. The system I/O bus, or system bus if only one bus structure is used, shall [6] be of a design that has been placed in the public domain, is derived from accepted industry/government standards, and/or is available for licensing from a vendor.

The Target WIS Workstation bus architecture shall [7] be designed to provide the necessary handshaking and bus arbitration logic to allow the inclusion of additional specialized auxiliary processor cards (e.g., array co-processors, specialized graphics hardware, parallel processors, etc.) and other potential hardware that require bus master privileges to access workstation resources within the system.

The Target WIS Workstation configurations shall [8] provide a minimum of three (3) system I/O bus card locations, or system bus card locations if one bus is used in the architecture, in excess of those slots required for supporting the minimum Target Workstation system configuration as outlined in Table III.

3.3.2.1.11. Target Workstation Backplane Data Rate Requirements

The Target WIS Workstation shall [1] support a minimum data transfer rate along the memory subsystem bus of ten (10) megawords/second. One word is the length of the data component of the memory subsystem bus (32 bits). The Target WIS Workstation shall [2] support a minimum data transfer rate along the I/O subsystem bus of three (3) megawords/second, where one word is the length of the data component of the I/O subsystem bus (16 or 32 bits).

3.3.2.1.12. Target Workstation Clock and Calendar

A time-of-day clock and calendar function shall [1] be provided in the Target Workstation design. The clock shall [2] provide a indication of the time-of-day to software that wishes to use this information. The calendar shall [3] provide an indication of the calendar date (year, month, day) to software that wishes to use this information. The calendar shall [4] provide adjustments based on leap year calculations. Both the clock and calendar shall [5] be provided with battery backup to maintain the timekeeping functions while the workstation is powered down. The battery backup shall [6] be capable of disconnection to effect complete de-classification of the workstation equipment, when necessary. The battery shall [7] provide power to the clock and calendar system, only. The battery shall [8] be readily available in the commercial marketplace, worldwide. Software to set and examine both the clock and calendar data by the workstation user shall [9] be provided for use with the Target WIS Workstation multi-tasking operating system.

3.3.2.1.13. Target Workstation Computer System Power Supply

The Target WIS Workstation power supply shall [1] be of adequate size to provide sufficient power for all included cards and peripheral equipment carried in the system unit, as well as providing a 20% reserve power for additional cards and equipment. The reserve shall [2] be measured on a minimum configuration as defined in Table VIII, with all open slots filled with sufficient memory cards or modules to bring the system memory size to the maximum amount allowed (16 megabytes minimum, or "best bid").

3.3.2.1.14. Target Workstation Display Capabilities

The Target Workstation shall [1] provide, as part of the nominal configuration, a display monitor that meets the requirements of the Medium Screen monitor (3.3.3.2.3). The Target Workstation shall [2] provide, as part of the nominal configuration, a video processing capability that meets the requirements of the Medium Resolution video processing capability, as described in 3.3.3.1.2. The Target Workstation shall [3] be capable of using any of the video systems described in 3.3.3.

3.3.2.1.15. Target Workstation Audio Output

The Target WIS Workstation shall [1] provide an audio output subsystem. The Target WIS Workstation audio output subsystem shall [2] provide the capability to allow application programs to control the pitch (frequency and time characteristics), duration, and volume of the tones emitted by the output device.

3.3.2.1.16. Target Workstation Diagnostic Capabilities

The Target WIS Workstation shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for diagnosis (i.e., go/nogo, pass/fail types of tests) of hardware faults.

3.3.2.1.17. Target Workstation Growth Capabilities

The system architecture of the Target Workstation shall [1] be of such a design that the workstation system will be able to support additional processor growth and incorporate new advances in processor technology.

3.3.2.2. Target Workstation Computer Software Requirements

Conditions on the requirements for the software described in 3.1.4 that are specific to the Target Workstation are contained in this paragraph. No known conflicts exist between the requirements stated in this paragraph, or in 3.1.4; however, if a conflict is discovered, the requirements in this section shall [1] take precedence over the requirements contained in 3.1.4.

3.3.2.2.1. Target Workstation Operating System Software

A multi-tasking operating system is required to be supplied with the Target Workstation. The Target Workstation shall [1] be capable of executing correctly a multi-tasking operating system that meets the requirements of 3.1.4.2.1.

Initialization processing shall [2] take no longer than three (3) minutes on the Target Workstation when the associated disk system is 80% full, and file system checking is enabled on startup. Initialization processing shall [3] take no longer than one (1) minute on the Target Workstation when file system checking is disabled on startup. Shutdown processing shall [4] take no longer than two (2) minutes to complete on the Target Workstation when performing basic shutdown activities (i.e, not including either LAN closeout software, or user/site designated processing). The shutdown processing times shall [5] include file system integrity checking, if enabled.

3.3.2.2.2. Target Workstation Language Translator Systems

An Ada development environment is required for development of WIS applications for the Target Workstation. The Target Workstation Ada development system shall [1] meet the requirements contained in 3.1.4.2.2 of this Specification. The Ada development system shall [2] produce Target Workstation native machine code usable with the Target Workstation multi-tasking operating system, and other application development support software packages defined in 3.1.4.2. The Ada system shall [3] be hosted on the Target WIS Workstation.

Instances of all other compilers described in 3.1.4.2.2 shall [4] exist for use with the Target Workstation, and shall [5] execute correctly on the Target WIS Workstation. All other compilers shall [6] produce native machine code for the Target WIS Workstation, and shall [7] be operate under control of and be compatible with the multi-tasking operating system, and all application development support software packages that exist on the workstation.

3.3.2.2.3. Target Workstation Program Development Services Software

The Target Workstation is required to host versions of the programming support software packages described in 3.1.4.2.3. The Target Workstation applications development software packages shall [1] be compatible with the Target Workstation Ada compilation system described in 3.3.1.2.2, and shall [2] execute correctly in conjunction with the Target Workstation multi-tasking operating system described in 3.3.1.2.1.

3.3.2.2.4. Target Workstation User Services Software

Software which integrates a subset of the functions described in 3.1.4.3 is required for use with the Target WIS Workstation. The Target Workstation shall [1] be capable of executing correctly an integrated software suite whose individual components meet the requirements of the following User Services capabilities described in 3.1.4.3:

a. Word Processing (3.1.4.3.3),
b. Spreadsheet (3.1.4.3.4),
c. Database Management (3.1.4.3.5), and
d. Basic Graphics (3.1.4.3.6.1 and 3.1.4.3.6.2).

An integrated software suite is a software environment which consists of functional modules that have been created to work together as an integrated system. Characteristics that indicate the degree of integration include:

a. Consistency of the user interface across different functional modules,
b. Capabilities to pass and incorporate data from one module to the next, and
c. Ability to move between various modules.

Integration of the required functions can occur through the use of a monolithic software package, or through the use and enforcement of a standardized environment (such as an operating system) that provides the integration function.

The Target Workstation shall [2] be capable of executing correctly a software suite that implements a VT-240 terminal emulation capability meeting the requirements of 3.1.4.3.7.

All Target WIS Workstation user services software shall [3] execute within, and under the control of the native environment supplied by the Target Workstation multi-tasking operating system described in 3.3.1.2.1.

3.3.2.2.5. Target Workstation MS-DOS Software Support

The Target WIS Workstation shall [1] maintain an environment that provides for the correct execution of the selected MS-DOS-based software described in 3.1.4.2.1.15. The Target WIS Workstation multi-tasking operating system shall [2] provide this environment as a set of sub-tasks within the overall control of the multi-tasking operating system. A minimum of five (5) MS-DOS environment emulation tasks shall [3] be provided by the Target WIS Workstation multi-tasking operating system.

3.3.3. Video Displays

3.3.3.1. Video Processing Capabilities

This section describes the requirements for the Video Processing capabilities required for both the Basic and Target WIS Workstation systems. All video processing capabilities shall [1] work correctly with both the Basic and Target WIS Workstation systems.

All Video Processing subsystems shall [2] provide, as a minimum, the following text display attributes:

a.) bold,
b.) blinking,
c.) reverse video.

The color of displayed text shall [3] be capable of being set to any of the colors supported by the specific subsystem. The background color of the display screen shall [4] be capable of being set to any of the colors supported by the specific subsystem, independent of the text color. A means to change and access the current text color, background screen color, and text display attributes from within application programs shall [5] be provided.

3.3.3.1.1. Low Resolution Video Processing Subsystem

The Low Resolution Video Processing subsystem shall [1] provide a color graphics video display capability with a minimum resolution of 640 (horizontal) x 480 (vertical) pixels. The video system shall [2] simultaneously display at least sixteen (16) colors selectable from a palette of a minimum of sixty-four (64) colors at the required resolution. The Low Resolution Video Processing subsystem shall [3] be capable of the writing to and addressing each pixel within the display for the purpose of displaying graphics oriented data. The display shall [4] be capable of coloring each pixel location with any of the colors supported by the display.

The Low Resolution Video Processing subsystem shall [5] provide at least 25 lines of data containing at least 80 characters per line. All characters shall [6] have sharply defined edges. The screen shall [7] be capable of displaying the full 95 displayable characters contained as part of the ASCII character set in any character position contained within any line of the display. All characters shall [8] be readable from a distance of 3.5 feet, in accordance with the requirements of MIL-STD-1472.

The Low Resolution Video Processing subsystem shall [9] be usable with all WIS Workstation display screen capabilities (Small, Medium, and Large).

The Low Resolution Video Processing subsystem shall [10] provide an auxiliary color video output port to support a second display device. The auxiliary color video output shall [11] comply with the EIA RS-170A standard RGB interface definition.

3.3.3.1.2. Medium Resolution Video Processing Subsystem

The Medium Resolution Video Processing subsystem shall [1] provide a color graphics video display capability with a minimum resolution of 1024 (horizontal) x 768 (vertical) pixels. The video system shall [2] simultaneously display at least sixteen (16) colors selectable from a palette of a

minimum of sixty-four (64) colors at the required resolution. The Medium Resolution Video Processing subsystem shall [3] be capable of the writing to and addressing each pixel within the display for the purpose of displaying graphics oriented data. The display shall [4] be capable of coloring each pixel location with any of the colors supported by the display.

The Medium Resolution Video Processing subsystem shall [5] provide, as a minimum capability, the following text formats: 25 lines of data containing at 80 characters per line, 25 lines of 132 characters, 43 lines of 80 characters, and 43 lines of 132 characters. All characters shall [6] have sharply defined edges. The display subsystem shall [7] be capable of displaying the full 95 displayable characters contained as part of the ASCII character set in any character position contained within any line of the display. All characters shall [8] be readable from a distance of 3.5 feet, in accordance with the requirements of MIL-STD-1472.

The Medium Resolution Video Processing subsystem shall [9] be usable with the Medium and Large WIS Workstation display subsystems.

The Medium resolution Video Processing subsystem shall [10] provide an auxiliary color video output to support a second display device with all WIS Workstations.

3.3.3.1.3. High Resolution Video Processing Subsystem

The High Resolution Video Processing subsystem shall [1] provide color graphics video display capability with a minimum resolution of 1280 (horizontal) x 1024 (vertical) pixels. The video system shall [2] simultaneously display at least two hundred fifty-six (256) colors selectable from a palette of a minimum of four thousand ninety-six (4096) colors at the required resolution. The High Resolution Video Processing subsystem shall [3] be capable of the writing to and addressing each pixel within the display for the purpose of displaying graphics oriented data. The High Resolution Video Processing Capability shall [4] be capable of coloring each pixel location with any of the colors supported by the display.

The High Resolution Video Processing subsystem shall [5] provide, as a minimum capability, the following text formats: 25 lines of data containing at 80 characters per line, 25 lines of 132 characters, 43 lines of 80 characters, and 43 lines of 132 characters. All characters shall [6] have sharply defined edges. The High Resolution Video Processing subsystem shall [7] be capable of displaying the full 95 displayable characters contained as part of the ASCII character set in any character position contained within any line of the display. All characters in all modes shall [8] be readable from a distance of 3.5 feet, in accordance with the requirements of MIL-STD-1472.

The High Resolution Video Processing subsystem shall [9] be usable with the Medium and Large WIS Workstation display systems.

The High Resolution Video Processing subsystem shall [10] provide an auxiliary color video output to support a second display device with all WIS Workstations.

3.3.3.2. Display Screen Capabilities

3.3.3.2.1. General Screen Requirements

All WIS Workstation Displays shall [1] have user adjustable screen controls (brightness, contrast, intensity, color purity, etc.). The screens shall [2] be non-interlaced providing a flicker and jitter-free display. The display shall [3] be impervious to moire patterns with or without the TEMPEST shielding. All display screens shall [4] be free of objectionable pincushion, trapizoidal and other distortions, as well as "weaving" effects, and provide consistent converged colors across the entire screen. The screens of all displays shall [5] consist of a non-glare surface.

All WIS Workstations shall [6] provide a "screen saver" feature where the display screens are blanked after a period of non-use of the display. This feature is needed in order to minimize the effects of information "burn-in" on the display screen. All WIS Workstations shall [7] provide a utility (either software or hardware) that displays a color bar suitable for adjusting the display color settings.

All displays shall [8] be equipped with connecting cables that are at least five (5) feet in length to allow placement of the system unit on the floor.

3.3.3.2.2. Small Screen Display Subsystem

The Small Screen Display subsystem shall [1] provide a color graphics display for both the Basic and Target Workstations. The Small Screen Display screen shall [2] be at least twelve (12) inches measured diagonally.

3.3.3.2.3. Medium Screen Display Subsystem

The Medium Screen Display subsystem shall [1] provide a color graphics display for both the Basic and Target Workstations. The Medium Screen Display screen shall [2] be at least fourteen (14) inches measured diagonally.

3.3.3.2.4. Large Screen Display Subsystem

The Large Screen Display subsystem shall [1] provide a large color graphics display for both the Basic and Target Workstations. The Large Screen Display screen shall [2] be at least nineteen (19) inches measured diagonally.

3.3.4. Keyboards

The Basic and Target WIS Workstations are required to contain keyboards as the primary input device for entry of textual and control information. The Basic and Target Workstation keyboards:

a. Shall [1] contain standard typewriter keys, a minimum of twelve (12) programmable function keys, a separate numeric keypad, and separate control keypads for display scrolling, stepping, cursor positioning, and screen editing,

b. Shall [2] conform to the ANSI standard X4.23-1982 key layout,

c. Shall [3] be capable of generating the entire 128 character ASCII character set as defined in FIPS Publication 1-2,

d. Shall [4] have all displayable characters within the character set clearly marked on the keyboard as to the key that generates the characters,

e. Shall [5] clearly assign common control characters (e.g., ESC, BACKSPACE, RETURN, TAB, DELETE, CONTROL, and BREAK) to labelled keys within the keyboard,

f. Shall [6] provide for a minimum of eight (8) cursor positioning keys (UP, DOWN, LEFT, RIGHT, HOME, END, PAGE UP, and PAGE DOWN),

g. Shall [7] contain a total number of keys that is less than or equal to 110,

h. Shall [8] provide an "N-key" rollover capability to capture multiple simultaneous keystrokes,

i. Shall [9] provide audible and/or tactile feedback for key depression, and

j. Shall [10] provide an auto repeat function for keys associated with all printable ASCII characters, cursor control characters, the space bar, and backspace and delete functions, and

k. Shall [11] provide indications of the CAPS LOCK status, and other types of keyboard "modes" that are supported by the keyboard.

The keyboard shall [12] be detachable from the system unit so that independent placement of the keyboard and system unit can be effected. The keyboard cable connection shall [13] be a minimum of five (5) feet in length to allow for placement of the system unit on the floor.

3.3.5. Auxiliary Storage

3.3.5.1. General

Both the Basic and Target WIS Workstation are required to support various types of auxiliary storage capabilities. Requirements for these capabilities are defined in the following sub-paragraphs.

Both the Basic and Target WIS Workstations shall [1] contain the following auxiliary storage components as part of the standard workstation configuration:

(1) 40 MB High Capacity Random Access Storage System (removable),
(1) 40 MB High Capacity Random Access Storage System (lockable), and
(1) 3.5" Microfloppy Low Capacity Random Access Disk Storage System.

All WIS Workstation architectures shall [2] be capable of incorporating additional disk drive options including higher capacity storage disk units, low capacity storage disk units, backup systems, and archival systems, as defined in the following sub-paragraphs.

Both the Basic and Target WIS Workstations shall [3] employ drives that are media compatible with the other workstation model where removable media systems are employed (floppy, microfloppy, and high capacity drives).

3.3.5.2. High Capacity Random Access Storage

3.3.5.2.1. Fundamental Storage Capacities

The Basic and Target WIS Workstations shall [1] contain a minimum of eighty (80) megabytes (unformatted) of high capacity random access (read/write) storage as part of the minimum workstation configuration, consisting of two (2) random access disk drives each with a minimum of forty (40) megabytes (MB) of contiguous storage capacity. One of these fundamental 40 megabyte workstation units shall [2] be removable in order to hold and contain classified data files. The remaining fundamental unit shall [3] be lockable to contain audit data, operating system software, and unclassified application software. A lockable disk drive is a removable disk drive that is physically protected from removal except by authorized personnel. Operating system file system protection capabilities shall [4] be employed on all lockable unit directories to ensure that only duly authorized personnel are able to read and write operating system software and audit data files. A directory to contain user-installable applications programs shall [5] be provided on the 40 MB lockable unit.

3.3.5.2.2. Expansion Storage Capacities

The Basic and Target WIS Workstation high capacity random access storage subsystems shall [1] be capable of incorporating additional expansion disk drive units in various increments of storage capacity (20, 40, 80, 160, 240 MB), up to a minimum of two hundred-forty (240) megabytes (unformatted) per expansion disk unit. The fundamental removable disk unit shall [2] be replaceable by any of the expansion units. These expansion units shall [3] provide contiguous storage of the given increment size. Expansion disk units shall [4] use the same disk controller(s) as the fundamental units. The disk units themselves may use either removable or fixed MEDIA for the expansion drives, however, all expansion disk drives shall [5] be removable, as defined in the Glossary.

The high capacity random access storage controllers shall [6] be capable of accessing up to a minimum of four (4) disk drive units. All WIS Workstations (Basic and Target) shall [7] be capable of using a minimum of two (2) high capacity random access storage controllers.

3.3.5.2.3. Storage Controller and Operating System Requirements

The Basic and Target WIS Workstation multi-tasking operating systems and disk controllers shall [1] be capable of addressing the entire formatted disk medium as a single logical partition for all increments of the high capacity random access storage subsystem storage disk drive units (both fundamental and expansion units). Disk partition size shall [2] be limited only by the physical limitations of the disk drives. The Basic and Target WIS Workstation multi-tasking operating systems and disk controllers shall [3] be capable of supporting a minimum of four (4) logical partitions per physical disk volume. Utilities shall [4] be provided as part of the Basic and Target Workstation multi-tasking operating systems for determining and defining disk partitions, formatting the disk, and performing other physical disk maintenance tasks.

3.3.5.2.4. High Capacity Storage COMSEC Requirements (GRAY)

The high capacity random access storage controllers shall [1] be capable of incorporating embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the disk media and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.3.5.2.5. Performance

The Basic and Target WIS Workstation high capacity random access storage drive units shall [1] perform random seek accesses in a time period not to exceed 35 milliseconds (ms), on average. This access time requirement shall [2] apply to the fundamental devices supplied as part of the nominal WIS Workstation configuration and the expansion units.

3.3.5.3. Low Capacity Random Access Storage

3.3.5.3.1. 3.5" Floppy Disk Storage

The Basic and Target WIS Workstations shall [1] contain a minimum of one (1) 3.5 inch microfloppy disk drive and associated controller. Each microfloppy disk shall [2] store a minimum of 1.4 megabytes of data. The microfloppy controller for both the Basic and Target WIS Workstation 3.5" microfloppy disk subsystems shall [3] interface and control a minimum of two (2) microfloppy disk drives.

The Basic and Target WIS Workstation multi-tasking operating systems shall [4] be capable of using the microfloppy disk subsystem as regular disk storage units, as well as backup units.

The Basic and Target WIS Workstations shall [5] be capable of formatting, reading, and writing reliably (see 3.4 for reliability figures) microfloppy disks compatible with the MS-DOS version 3.3 operating system using the 3.5" floppy disk subsystem. MS-DOS-based format, read, and write

operations shall [6] be capable of initiation from within the native environment supplied by the multi-tasking operating system, as well as from within the single-task, single-user MS-DOS emulation environment.

The Basic and Target WIS Workstation multi-tasking operating systems shall [7] be capable of using the microfloppy disk subsystem as regular disk storage units, as well as backup units.

3.3.5.3.2. 5.25" Floppy Disk Storage

The Basic and Target WIS Workstations shall [1] support the use of a minimum of one (1) floppy disk drive and associated controller. The floppy disk drive shall [2] support the use of 5.25 inch floppy disk media. Each floppy diskette shall [3] be capable of storing 1.2 megabytes of data, as a minimum. The floppy disk drive controller shall [4] be capable of supporting a minimum of two (2) floppy drives.

The Basic and Target WIS Workstations shall [5] be capable of formatting, reading, and writing reliably (see 3.4 for reliability figures) floppy disks compatible with the WIS Early Products Workstation and WIS Block A Release 1 Workstation (see Appendices I, II, and III) operating systems using the 5.25" floppy disk subsystem. MS-DOS-based format, read, and write operations shall [6] be capable of initiation from within the native environment supplied by the multi-tasking operating system, as well as from within the single-task, single-user MS-DOS emulation environment.

The Basic and Target WIS Workstation multi-tasking operating systems shall [7] be capable of using the floppy disk subsystem as regular disk storage units, as well as backup units.

3.3.5.3.3. Low Capacity Storage COMSEC Requirements (GRAY)

The low capacity random access storage controllers shall [1] be capable of incorporating and/or using embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the disk media and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.3.5.4. Backup System

3.3.5.4.1. Basic Requirements

The Basic and Target WIS Workstations shall [1] support the use of tape or another media based system for backup storage of high capacity random access storage system-resident data and software. The backup system shall [2] provide a minimum of forty (40) megabytes (MB) of storage per individual medium item (e.g., a tape cassette, disk cartridge, etc.). Associated backup software shall [3] be supplied with backup system hardware, and shall [4] be compatible with the high capacity random access storage device formats defined by the multi-tasking operating system(s) in use on all WIS Workstations (Basic and Target), as well as any emulation environments. The backup system hardware and software shall [5] execute correctly while controlled by the Basic and Target WIS Workstation multi-tasking operating system. The backup software shall [6] provide capabilities to manage and support data and/or program files that span physical backup volumes. The backup system and software shall [7] provide the capability to list the contents of a related set of backup media. The backup system and software shall [8] support the

full restoral of all contents of a related set of media. The backup system and software software shall [9] provide the capability to selectively restore various files from a related set of media.

3.3.5.4.2. Backup Storage COMSEC Requirements (GRAY)

The backup system controllers shall [1] be capable of incorporating and/or using embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the backup system media and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.3.5.5. Archival Storage System (GRAY)

3.3.5.5.1. Operating Mode and Media

The Basic and Target WIS Workstation archival storage systems shall [1] operate in a Write-Once, Read-Many (WORM) mode, allowing the storage of data for archiving, and the retrieval of that data; however, modification of the data is impossible. Optical media shall [2] be used for archival storage.

3.3.5.5.2. Storage Capacity

The Basic and Target WIS Workstation archival storage systems shall [1] provide a minimum of two hundred-forty (240) megabytes of storage per medium item.

3.3.5.5.3. Archival Storage Controller and Operating System Requirements

The Basic and Target WIS Workstation archival storage controllers shall [1] work correctly in conjunction with the Basic and Target WIS Workstation multi-tasking operating system software, and other emulation environments. Access to the archival storage units by workstation application programs shall [2] operate in the same manner as the high capacity random access storage subsystem, in terms of interface support by the operating system, and the effects of controller operations on the application program.

The archival storage disk controller shall [3] support a minimum of four (4) archival disk storage units.

3.3.5.5.4. Performance

The Basic and Target WIS Workstation archival storage drive units shall [1] perform random seek accesses in a time period not to exceed 80 milliseconds (ms), on average.

3.3.5.5.5. Archival Storage Embedded COMSEC Requirements

The high capacity random access storage controllers shall [1] be capable of incorporating embedded COMSEC encryption technology as part of the controller architecture, to encrypt/decrypt data as data blocks are passed between the archival media and the workstation processor system. Embedded COMSEC protection devices shall [2] be obtained from the National Security Agency (NSA) Commercial COMSEC Endorsement Program (CCEP) approved products list for use in both Basic and Target Workstations.

3.3.6. Alphanumeric Print Capability

The Alphanumeric Print Capability is designed to provide a high-quality text-only document hard copy capability for use by workstations intended to support text-only applications. A major requirement of this printer is to produce documents that can be read reliably by Optical Character Readers (OCRs) using both OCR-A and OCR-B fonts.

3.3.6.1. Alphanumeric Print Capability Interface Requirements

The the printer providing the Alphanumeric Print Capability shall [1] interface to the WIS Workstations using one of the interfaces described in 3.1.7.3.2 and 3.1.7.3.3.

3.3.6.2. Alphanumeric Print Capability Word Size

The printer providing the Alphanumeric Print Capability shall [1] be capable of supporting 8-bit data streams generated from the WIS Workstation. Printers that communicate through use of serial interfaces shall [2] be able to support 7-bit data streams with the appropriate resetting of system switches, or another setup protocol supplied by the Printer.

3.3.6.3. Alphanumeric Print Capability Print Standards

The Alphanumeric Printer shall [1] print the full 95 ASCII printable characters (including spaces) in accordance with FIPS Publication 1-2. A minimum of five (5) fonts; Courier, Prestige Elite, Orator, OCR-A, and OCR-B, shall [2] be supplied. All OCR fonts shall [3] meet the requirements of the following standards, where applicable:

ANSI X3.17-1981,	OCR A Font Description;
ANSI X3.49-1975,	OCR-B Font Description (Revised 1982);
FIPS Publication 89,	OCR Character Positioning; and
FIPS Publication 90,	Guidelines for OCR Print Quality.

The printer inks used with the printer providing the Alphanumeric Print Capability shall [4] meet the requirement of FIPS Publication 85, "OCR Inks", paragraphs 1.0, 2.1, 3.1, and 4.0.

The printer providing the Alphanumeric Print Capability shall [5] produce documents that are acceptable for use as letter quality documents. When using the OCR fonts, both OCR-A and OCR-B, the Printer shall [6] produce documents that can be read by off-the-shelf Optical Character Reader (OCR) equipment reliably, in accordance with the reliability standards contained in 3.4.

3.3.6.4. Alphanumeric Print Capability Processing Speed

Letter quality mode type shall [1] be printed with a print speed of minimum thirty-five (35) characters/second, actual throughput. Print speeds shall [2] be sustained print speeds, measured by timings of actual Printer usage.

3.3.6.5. Alphanumeric Print Capability Printing Area Sizes

The printer providing the Alphanumeric Print Capability shall [1] be capable of printing lines with line widths of up to 132 characters/line, as a minimum, in their entirety without causing printer line wraparound. Paper widths ranging from 8-1/2 inches to 14-7/8 inches shall [2] be supported by the printer providing the Alphanumeric Print Capability. The printer providing the Alphanumeric Print Capability shall [3] provide various paper feed mechanisms including tractor (pin) feed, friction feed, and single sheet feed.

3.3.6.6. Alphanumeric Print Capability Paper Requirements

The printer providing the Alphanumeric Print Capability shall [1] require the use of normal computer and office quality bond paper, only. Special coated-type papers will not be supported in the WIS environment.

3.3.6.7. Alphanumeric Print Capability Noise Limitations

The printer providing the Alphanumeric Print Capability shall [1] produce no more than 55 dbA of sound during operation. Noise measurements shall [2] be made during periods of highest speed and sustained duration of printing, and without use of special acoustic enclosures.

3.3.6.8. Alphanumeric Print Capability Diagnostic Capabilities

The printer providing the Alphanumeric Print Capability shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for execution on the WIS Workstations to allow for diagnosis of possible hardware faults.

3.3.7. Color Graphics Print Capability

The Color Graphics Print Capability provides a general purpose print capability to support generic printing requirements on the WIS Workstation. The printer has been specified to meet the requirements for relatively quick print capabilities, with a moderate level of print quality suitable for most workstation-based needs, with the additional support for color reproduction.

3.3.7.1. Color Graphics Print Capability Interface Requirements

The printer providing the Color Graphics Print Capability shall [1] interface to the WIS Workstation using one of the interfaces described in 3.1.7.3.2 and 3.1.7.3.3.

3.3.7.2. Color Graphics Print Capability Word Size

The printers providing the Color Graphics Print Capability shall [1] be capable of supporting 8-bit data streams generated from the WIS Workstation. Printers connected to the WIS Workstations using serial ports and hardware shall [2] be able to support 7-bit data streams with the appropriate resetting of system switches, or other setup protocol supplied by the Printer.

3.3.7.3. Color Graphics Print Capability Print Standards

The printer providing the Color Graphics Print Capability shall [1] print the full 95 ASCII printable characters (including spaces) in accordance with FIPS Publication 1-2. A minimum of three (3) typefaces (Prestige Elite, Courier, Orator) in various combinations of point sizes shall [2] be supplied. Font sizes for supplied typefaces shall [3] range from 9 points to 18 points (1 point = 1/72 of an inch).

OCR-A, and OCR-B fonts shall [4] be supplied. All OCR fonts shall [5] meet the requirements of the following standards, where applicable:

ANSI X3.17-1981,	OCR A Font Description;
ANSI X3.49-1975,	OCR-B Font Description (Revised 1982);
FIPS Publication 89,	OCR Character Positioning; and
FIPS Publication 90,	Guidelines for OCR Print Quality.

The printer inks used with the printer providing the Alphanumeric Print Capability shall [6] meet the requirement of FIPS Publication 85, "OCR Inks", paragraphs 1.0, 2.1, 3.1, and 4.0.

The printer providing the Color Graphics Print Capability shall [7] support a minimum of three qualities of alphanumeric print type: draft, correspondence, and letter quality.

The printer providing the Color Graphics Print Capability shall [8] provide the ability to generates lines of arbitrary lengths and orientations. Alphanumeric and graphic data shall [9] be capable of being intermixed on the same page by the Printer.

The printer providing the Color Graphics Print Capability shall [10] provide a graphics resolution of at least 150 dots/inch (horizontal) by 80 dots/inch (vertical). The printer providing the Color Graphics Print Capability shall [11] be capable of printing lines of arbitrary complexity, as well as providing for filling, shading, and other graphics operations.

The printer providing the Color Graphics Print Capability shall [12] be capable of supporting the generation of color images. Seven colors (red, green, yellow, blue, cyan, magenta, and black) shall [13) be provided. The ink set used to generate the images shall [14) be capable of generating a minimum of 500 copies.

3.3.7.4. Color Graphics Print Capability Printing Area Sizes

The printer providing the Color Graphics Print Capability shall [1] be capable of printing lines with line widths of up to 132 characters/line, as a minimum, in their entirety without causing print wraparound. The printer providing the Color Graphics Print Capability shall [2] provide the capability to support paper widths ranging from 8-1/2 inches to 14-7/8 inches. The printer providing the Color

Graphics Print Capability shall [3] support various paper feed mechanisms including tractor (pin) feed, friction feed, and single sheet feed.

3.3.7.5. Color Graphics Print Capability Paper Requirements

The printer providing the Color Graphics Print Capability shall [1] require the use of normal computer and office quality bond paper, only. Special coated-type papers will not be supported in the WIS environment. The printer providing the Color Graphics Print Capability shall [2] be capable of printing on transparent media.

3.3.7.6. Color Graphics Print Capability Processing Speed

Draft quality mode type shall [1] be printed at a minimum print speed of 200 characters/second, actual throughput. Correspondence mode type shall [2] be printed at a minimum print speed of 65 characters/second, actual throughput. Letter quality mode type shall [3] be printed at a minimum print speed of 35 characters/second, actual throughput. All print speeds shall [4] be sustained print speeds, measured by timings of actual usage of the Printer.

3.3.7.7. Color Graphics Print Capability Noise Limitations

All printers providing the Color Graphics Print Capability shall [1] produce no more than 55 dbA of sound during operation. Noise measurements shall [2] be made during periods of highest speed and sustained duration of printing.

3.3.7.8. Color Graphics Print Capability Diagnostic Capabilities

The printer providing the Color Graphics Print Capability shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for execution on the WIS Workstation to allow for diagnosis of possible hardware faults.

3.3.8. Page-Oriented Print Capability

The Page-Oriented Print Capability is designed to provide the capability to produce high-quality reports and documents that can mix graphics and text within the same page. Multiple fonts within a document, multiple print styles within a document, and other typeface features are the hallmarks of this type of printer.

3.3.8.1. Page-Oriented Print Capability Interface Requirements

The printer providing the Page-Oriented Print Capability shall [1] interface to the WIS Workstation using one of the interfaces described in 3.1.7.3.2 and 3.1.7.3.3.

3.3.8.2. Page-Oriented Print Capability Word Size

The printer providing the Page-Oriented Print Capability shall [1] be capable of supporting 8-bit data streams generated from the WIS Workstation. Printers connected to WIS Workstation using serial interfaces shall [2] be able to support 7-bit data streams with the appropriate resetting of system switches, or other setup protocol supplied by the Printer.

3.3.8.3. Page-Oriented Print Capability Print Standards

The printer providing the Page-Oriented Print Capability shall [1] support the full 95 ASCII printable characters (including spaces) in accordance with FIPS Publication 1-2. Various typefaces shall [2] be supplied with the Printer; a minimum of four typefaces in various combinations of point sizes shall [3] be supplied. Font sizes shall [4] range from 9 points to 18 points. The printer providing the Page-Oriented Print Capability shall [5] provide the capability to download fonts to the printer from the workstation. Font generation and editing software shall [6] be provided to support the generation and maintenance of downloadable fonts.

The printer providing the Page-Oriented Print Capability shall [7] support the following OCR fonts: OCR-A, and OCR-B. All OCR fonts shall [8] meet the requirements of the following standards, where applicable:

ANSI X3.17-1981,	OCR A Font Description;
ANSI X3.49-1975,	OCR-B Font Description (Revised 1982);
FIPS Publication 89,	OCR Character Positioning; and
FIPS Publication 90,	Guidelines for OCR Print Quality.

The printer inks shall [9] meet the requirement of FIPS Publication 85, "OCR Inks", paragraphs 1.0, 2.1, 3.1, and 4.0.

The printer providing the Page-Oriented Print Capability shall [10] produce documents that are acceptable for use as letter quality documents. When using the OCR fonts, both OCR-A and OCR-B, the Printer shall [11] produce documents that can be read by off-the-shelf Optical Character Reader (OCR) equipment reliably, in accordance with the reliability standards contained in 3.4.

The printer providing the Page-Oriented Print Capability shall [12] be capable of generating lines of arbitrary lengths and orientations. The printer providing the Page-Oriented Print Capability shall [13]

provide a graphics resolution of at least 300 dots/inch (both horizontal and vertical dimensions. The printer providing the Page-Oriented Print Capability shall [14] be capable of printing sets of lines of arbitrary complexity, as well as providing for filling, shading, and other graphics operations. The printer providing the Page-Oriented Print Capability shall [15] be capable of mixing alphanumeric and graphic data on the same page.

The printer providing the Page-Oriented Print Capability shall [16] support the use of a page description language to describe page layout, page contents, fonts, and other printing parameters. The page description language shall [17] possess the following characteristics:

a. It is supported by a wide variety of commercial software, especially desktop publishing software,

b. It is supported on a wide range of printer products within the printer industry,

c. It provides the ability to intermix graphics, bit-mapped images and text on the same page,

d. It supports the ability to have multiple (more than three) fonts in various styles (bold, italic, etc.) on the same page,

e. It supports the development of new typefaces and fonts,

f. It is based on a language that has been placed in the public domain, or is readily licensable from the developer, of the language.

The printer providing the Page-Oriented Print Capability shall [18] support the use of the control conventions and print language supported by the Diablo 630 printer.

3.3.8.4. Page-Oriented Print Capability Printing Area Sizes

The printer providing the Page-Oriented Print Capability shall [1] support pages sizes of a minimum of 8-1/2 by 11 inches, and 8-1/2 by 14 inches. The printer providing the Page-Oriented Print Capability shall [2] be capable of printing both in the vertical direction ("portrait" orientation), and in the horizontal direction ("landscape" orientation). The Printer shall [3] support various paper feed mechanisms including single sheet manual and automatic paper feed systems.

3.3.8.5. Page-Oriented Print Capability Paper Requirements

Printers providing the Page-Oriented Print Capability shall [1] require the use of commercial computer and office quality bond paper, only. Special coated-type papers will not be supported in the WIS environment. The printer providing the Page-Oriented Print Capability shall [2] support the capability to print on transparent media.

3.3.8.6. Page-Oriented Print Capability Processing Speed

Printers providing the Page-Oriented Print Capability shall [1] print with a page printing rate of a minimum of five (5) pages/minute, actual throughput. The page printing rate shall [2] be a sustained rate measured by timing actual usage of the Printer.

3.3.8.7. Page-Oriented Print Capability Noise Limitations

Printers providing the Page-Oriented Print Capability shall [1] produce no more than 55 dbA of sound during operation. Noise measurements shall [2] be made during periods of highest speed and sustained duration of printing, and without the use of any special acoustic enclosures.

3.3.8.8. Page-Oriented Print Capability Diagnostic Capabilities

The printer providing the Page-Oriented Print Capability shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for execution on the WIS Workstation to allow for diagnosis of possible hardware faults.

3.3.9. Data Processing Print Capability

The Data Processing Print capability is designed to provide a high-speed text-only capability for high-volume hard copy production. The printer providing the Data Processing Print Capability will allow the quick and efficient printing of high volumes of data. The printer is intended to provide a draft quality of print for internal use only. Letter quality output is not considered a requirement for this printer.

3.3.9.1. Data Processing Print Capability Interface Requirements

The printer providing the Data Processing Print Capability shall [1] interface to any of the WIS Workstations using one of the interfaces described in 3.1.7.3.2 and 3.1.7.3.3. Serially connected Printers shall [2] operate using a minimum of 9600 bits/second as the interface data rate.

3.3.9.2. Data Processing Print Capability Word Size

The printer providing the Data Processing Print Capability shall [1] be capable of supporting 8-bit data streams generated from the WIS Workstation. Printers connected to the serial interfaces shall [2] be able to support 7-bit data streams with the appropriate resetting of system switches, or other setup protocol supplied by the Printer.

3.3.9.3. Data Processing Print Capability Print Standards

The printer providing the Data Processing Print Capability shall [1] support the full 95 ASCII printable characters (including spaces) in accordance with FIPS Publication 1-2.

3.3.9.4. Data Processing Print Capability Printing Area Sizes

The printer providing the Data Processing Print Capability shall [1] be capable of printing lines with line widths of up to 132 characters/line, as a minimum. Paper widths ranging from 8-1/2 inches to 14-7/8 inches shall [2] be supported by these printers.

3.3.9.5. Data Processing Print Capability Paper Requirements

The printer providing the Data Processing Print Capability shall [1] require the use of normal computer and office quality bond paper, only. Special coated-type papers will not be supported in the WIS environment.

3.3.9.6. Data Processing Print Capability Processing Speed

Data Processing print speeds shall [1] produce documents at a minimum rate of 600 lines/minute, actual throughput, where each line contains 132, or the maximum characters per line whichever is the larger, non-blank displayable characters. This print rate shall [2] be a sustained rate, measured by timing on actual usage of the printer.

3.3.9.7. Data Processing Print Capability Noise Limitations

Printers providing the Data Processing Print Capability shall [1] produce no more than 65 dbA of sound during operation. Noise measurements shall [2] be made during periods of highest speed and sustained duration of printing, and without use of special acoustic enclosures.

3.3.9.8. Data Processing Print Capability Diagnostic Capabilities

The printer providing the Data Processing Print Capability shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the WIS Workstation equipment for use. Diagnostic software shall [2] be provided for execution on all WIS Workstations to allow for diagnosis of possible hardware faults.

3.3.10. High Quality Graphics Print Capability

The WIS Workstation High Quality Graphics Printer provides a capability to directly produce high quality graphics hardcopy by reproducing the WIS Workstation display screen images on various film-based media (35 mm slides, 8"x10" transparencies, etc.).

3.3.10.1. Interface Requirements

The High Quality Graphics Printer shall [1] interface to the Low and Medium WIS Workstation video displays, including the Low, Medium, and High resolution video processing capabilities.

3.3.10.2. Media Support

The High Quality Graphics Printer shall [1] support, as a minimum, the generation of 8"x10" transparencies and 35 mm slides. Slides and transparencies shall [2] be produced at a minimum rate of 1 copy every 6 minutes. The slides and transparencies produced shall [3] have an effective resolution consistent with the quality associated with photographic based output products.

3.3.10.3. Reproducibility

The High Quality Graphics Printer shall [1] reproduce the WIS Workstation video displays without change, including the support of color. Color reproduction shall [2] remain consistent across the entire output product. All scan frequencies supported by the WIS Workstation video displays shall [3] be supported by the High Quality Graphics Printer.

3.3.10.4. Diagnostic Capabilities

The High Quality Graphics Printer shall [1] perform diagnostic self-tests upon power-up to determine overall suitability of the High Quality Graphics Printer equipment for use. Diagnostic software compatible with the WIS Workstation shall [2] be provided that performs a limited diagnosis (go/nogo, pass/fail, etc.) of hardware faults contained within the High Quality Graphics Printer equipment suite.

3.3.11. Printer Sharing Systems

The Print Sharing Systems are designed to provide a capability that permits a single set of WIS Workstations to share a smaller set of printers. The Printer Sharing System provides a means by which access to a printer (or set of printers) can be mediated among a larger set of workstations.

3.3.11.1. Low Capacity System

The Low Capacity Printer Sharing System shall [1] provide the capability to multiplex a minimum of five (5) workstations to one printer. Workstation connection to a printer through the print sharing system shall [2] be made via electronic means as a minimum capability. The system shall [3] provide a buffering capability to allow the workstation to transfer data at a faster rate than the printer can print, and still retain all data. The print sharing system shall [4] be capable of supporting both serial and parallel printer connections.

3.3.11.2. High Capacity System

The High Capacity Printer Sharing System shall [1] provide the capability to multiplex a minimum of twenty (20) workstations to a minimum of four (4) printers. Workstation connection to a printer through the print sharing system shall [2] be made via electronic means as a minimum capability. The system shall [3] provide a buffering capability to allow the workstation to transfer data at a faster rate than the printer can print, and still retain all data. The print sharing system shall [4] be capable of supporting all printers supplied with the WIS Workstations.

3.3.12. Input Pointing Devices

Input devices based on the concept of "point and click" such as mice and trackballs will be supplied as part of the WIS Workstation equipment. The input devices shall [1] provide the capability to move a visible cursor on the display in a continuous fashion around the screen. The input device shall [2] be capable of operation using a maximum of one hand. The device shall [3] provide a minimum of one (1) and a maximum of three (3) buttons on the device to indicate "click" events to the WIS Workstation system. All software that is part of the WIS Workstation shall [4] be capable of interfacing with the input pointing device, and using the events and positions generated by the device to control actions of the software, where appropriate.

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3.4. Quality Factors

Requirements on the quality of the equipment to be provided to meet the needs of the WIS Workstation mission are contained herein. Requirements on the reliability, maintainability, and portability characteristics of the equipment are presented and discussed.

3.4.1. Reliability

The WIS Workstations, and workstation peripherals shall [1] each individually satisfy the requirements specified in the following sub-paragraphs. For reliability estimation purposes, the operating environment shall [2] be "ground fixed" (see Table 5.1.1-3 of MIL-HDBK-217E).

3.4.1.1. Mission Reliability

The Mean Time Between Critical Failures (MTBCF), for performance outages of two (2) minutes or more, shall [1] be as enumerated in Table IX, column 2, with contractor TBD values that shall [2] meet or exceed the values contained in Table IX, column 1. The critical functional performance requirements and MTCBF rates for all equipment described in this Specification are enumerated in Table IX, and in 3.4.1.4. Failure to meet any critical performance requirements for a period exceeding 2 minutes shall [3] be considered a critical failure. Restoral of operation through redundancy, restart, or other methods, in less than 2 minutes makes such outages not countable against the MTBCF numerical requirement. The total occurrence rate of service outages under 2 minutes from all sources shall [4] not exceed once per 200 hours. MTBCF measurements shall [5] include every instance of failure with a performance outage exceeding two (2) minutes in duration, from all sources, i.e., measurement of MTBCF rates includes all system outages and downtime due to hardware failures, firmware failures, software errors, design-caused operator errors, design-caused maintenance errors, no-trouble-found outages, intermittent failures, preventive maintenance deficiencies, etc..

3.4.1.2. Maintenance Reliability

The specified Mean Time Between Corrective Maintenance Action (MTBCMA) values shall [1] be as enumerated in column 4 of Table IX with contractor TBD values that shall [2] meet or exceed the values contained in Table IX, column 3. Failures remedied by system warm- or cold-start actions shall [3] be considered failures for purpose of maintenance reliability measurements.

3.4.1.3. Failure Independence and Failure Modes

To the lowest level practicable, and at least to the "unit level" (see MIL-STD-280A for definition of "unit level"), the design shall [1] be such that independence of failure and operation is preserved. Failure, damage or removal of one unit shall [2] not cause failures in, disturb operation of, or in any way adversely affect another unit (except to the extent that functional dependence is involved). Upon restoral of the failed element, normal operation shall [3] resume. For redundant items, no failure modes shall [4] exist which defeat the redundancy.

TABLE IX

Workstation Reliability Requirements
(Values specified in hours)

	1	2	3	4
	Specified MTBCF		Specified MTBCMA	
	TBD Value	Minimum Acceptable Value	TBD Value	Minimum Acceptable Value
Basic Workstation		2,000		2,000
Target Workstation		2,000		2,000
Alphanumeric Printer		2,000		2,000
Color Graphics Printer		2,000		2,000
Page-Oriented Printer		2,000		2,000
Data Processing Printer		2,000		2,000
Printer Switch		2,000		2,000
High Quality Graphics Printer		2,000		2,000
Input Pointing Device		100,000		100,000

3.4.1.4. Failure Definitions

General and specific failure definitions (types and classifications) shall [1] be in accordance with this Specification. Pattern failures shall [2] be as defined in the Glossary. All known pattern failures shall [3] be eliminated by corrective action.

3.4.1.4.1. Workstation Performance Requirements

A WIS Workstation (Basic and Target) is considered to be operating correctly when it has the capability to do the following without degradation:

a. Execute correctly all user services and system support software supplied with the WIS Workstation (Basic and Target), as specified in 3.1.4 without incurring processor, disk, or memory subsystem errors;

b. Format, read, and write floppy diskettes compatible with the Early Products workstation storage systems;

c. Respond to and initiate communications with other WIS Segments and components, individually and concurrently, directly (through direct connection) or via the WIS LAN as specified in 3.1.7.1, and satisfy the processing requirements specified in 3.3; and

d. Respond to and initiate communications with all Workstation Printers directly connected to the WIS Workstation and satisfy the processing requirements specified in 3.3.

If a WIS Workstation (Basic and Target) cannot perform the above functions, it shall [1] be considered failed.

3.4.1.4.2. Workstation Printer Performance Requirements

A WIS Workstation Printer (Alphanumeric, Color Graphics, and Data Processing) is considered to be operating correctly when it has the capability to do the following without degradation:

a. Respond to communications from the WIS Workstation components through direct connection and satisfy the printer processing requirements specified in 3.3; and

b. Produce OCR-compatible output products that can be read by the Government OCR reader equipment (for printers supplied to meet OCR print requirements).

If a WIS Workstation Printer cannot perform the above functions, it shall [1] be considered failed.

3.4.1.4.3. High Quality Graphics Printer Performance Requirements

A WIS Video printer is considered to be operating correctly when it has the capability to do the following without degradation:

a. Respond to communications from WIS Workstations directly (through direct connection) and satisfy the processing requirements specified in 3.3 and produce quality output products in accordance with the requirements specified in 3.3.10.

If a WIS Workstation High Quality Graphics Device cannot perform the above function, it shall [1] be considered failed.

3.4.1.4.4. Printer Sharing Systems

A WIS Printer Sharing System is considered to be operating correctly when it has the capability to do the following without degradation:

a. Respond to switch input from a user and switch the input stream into the printer to the requested workstation;

b. Respond to workstation commands to switch the printer stream; and

c. Transmit the entire data stream from the workstation to the printer without losing characters.

If a WIS Printer Sharing System cannot perform the above functions, it shall [1] be considered failed.

3.4.2. Modifiability

The WIS Workstations and workstation peripherals described in this Specification shall [1] each individually satisfy the modifiability requirements specified in the following sub-paragraphs.

3.4.2.1. Maintainability

The following requirements shall [1] be met by the prescribed trained personnel using the prescribed test equipment/software, technical manuals, and spare parts.

3.4.2.1.1. Mission Checkout and Restoral

3.4.2.1.1.1. Failure Detection

The Fraction of Failures Detected (FFD) and indicated to the user through built-in test capabilities (see glossary for definition of "built-in test capabilities") shall [1] be TBD%, which shall [2] exceed 75%.

3.4.2.1.1.2. Failure Detection False Alarms

The Mean Time Between False Alarms (MTBFA) shall [1] exceed 250 hours.

3.4.2.1.2. Corrective Maintenance - On Site, On Equipment

This corrective maintenance shall [1] be performed on end items of equipment and it shall [2] include detecting and isolating failures to the level of Line Replacement Units (LRU). The failed LRU shall [3] be removed and replaced and the system re-tested to assure serviceability. LRUs shall [4] be limited to units, assemblies, and sub-assemblies and parts (see MIL-STD-280A for definitions). These tasks shall [5] be accomplished via contractor logistic support (CLS) arrangements.

3.4.2.1.2.1. Fraction of Failures Isolated (FFI)

This measurement of maintainability is not required for the equipment described in this Specification.

3.4.2.1.2.2. Time to Repair

The Mean Time To Repair (MTTR) (hardware corrective maintenance) shall [1] be no greater than 60 minutes. Ninety five percent (95%) of all repairs shall [2] be completed in less than 180 minutes.

3.4.2.1.3. Corrective Maintenance - On Site, Off Equipment

This level of maintenance is not required for the equipment described in this Specification.

3.4.2.1.4. Corrective Maintenance - Depot Level

This level of maintenance is not required for the equipment described in this Specification.

3.4.2.1.5. Preventive Maintenance

The WIS Workstation equipment shall [1] be designed so that all preventive maintenance (PM) actions can be accomplished at the system operating location, i.e., to perform preventative maintenance actions cannot require removal of the equipment to an on-site shop location, or the returning of the equipment to an on-site or off-site maintenance depot. Preventive maintenance shall [2] be planned and executed so as to cause minimum system down time. PM tasks shall [3] take less than sixty (60) minutes and shall [4] be required no more than every six (6) months. When required during PM, the system mission capable operation as defined in 3.4.1.1 shall [5] be restored within ten (10) minutes. Operational capability will be disrupted only when necessary.

3.4.2.1.6. Maintainability Design Criteria

The equipment described in this Specification shall [1] be designed in accordance with best commercial practices that support and enhance the maintainability of the equipment.

3.4.2.2. Flexibility and Expansion

The WIS Workstations and peripheral equipment described in this Specification shall [1] be designed to enhance the ability of the systems to cope with change as user needs and WIS design evolves. The characteristics contained in these sub-paragraphs shall [2] be supported to the greatest extent possible in all WIS Workstation equipment.

3.4.2.2.1. Modularity

The design of the WIS Workstations, Workstation Printers, and Video Printers shall [1] be modular to facilitate changes in hardware and software components which are needed to accommodate future changes in operational requirements. Replaceable hardware and software components shall [2] be used.

3.4.2.2.2. Expandability and System Modification

The system design shall [1] provide for ease of future hardware and software expansion and modification with minimum impact on system operations. This shall [2] include expansion or modification of processing, message handling, display format and contents, and communications interfaces without major changes in system design. The system shall [3] be designed so that the installation and testing of new hardware and software components shall [4] have minimal impact on continued system operation.

3.4.3. Portability

The WIS Workstation equipment described in this Specification shall [1] be designed to withstand a minimal level of movement without causing damage to the equipment. The systems shall [2] be capable of supporting rapid deployment of the equipment with minimal amounts of effort to "tear down" the system and transport it to a new location. The workstation equipment shall [3] be capable of supporting transport in a variety of carriers (automobile, trucks, ships, airplanes, etc.). The WIS Workstation equipment shall be capable of operation while in transit (especially aboard ships) as long as the appropriate environment conditions, as specified in 3.2.2, are provided within the environment of the carrier.

3.5. Logistics

3.5.1. General

The logistics disciplines of DoD directive 5000.39 including logistics support for the system's life cycle shall [1] be integrated into the design and engineering constraints cited in other sections of this specification. Any support equipment, automatic test equipment and their associated software necessary to sustain maintenance functions shall [2] be considered part of the specified workstation equipment.

3.5.2. Support Concept

Maintenance shall [1] be performed as specified herein. The maintenance concept of "remove and replace" shall [2] be adhered to in the design of all WIS Workstation equipment.

The Government requires Contractor Logistical Support (CLS) as the primary maintenance method for support of the WIS Workstation, however, an important consideration in the design of the WIS Workstation is the ability of the equipment to support a government "remove and replace" maintenance capability during periods of backup maintenance. The remainder of paragraph 3.5 describes requirements intended to support this backup maintenance concept.

3.5.2.1. System Test Equipment

For the on-site, on-equipment level of maintenance, each type of test equipment and its failure isolation functions shall [1] be consistent with the requirements of 3.4.2.1.2. Hardware and software Built-In Test (BIT) capabilities shall [2] be used for fault detection and isolation to the maximum extent possible.

3.5.3. Support Facilities

This paragraph is not applicable to this Specification.

3.5.4. Supply

This paragraph is not applicable to this Specification.

3.5.5. Personnel

3.5.5.1. Operations Personnel

Government personnel at each WIS site will include one or more of the following categories:

a. Clerical personnel, who are responsible for input of large volumes of operational data, and for limited hardware maintenance on output peripheral devices;

b. Operational users, primarily officers and senior enlisted personnel, who will use the workstation to aid, support and supplement their ongoing decision making tasks; and

c. System administrators, who will maintain coordination and central control over access to WIS resources, monitor the ongoing performance of the system, monitor security parameters, and interact with maintenance personnel and system programmers when addressing problems in hardware or software.

3.5.5.2. Maintenance Personnel

Maintenance personnel will consist of contractor-supplied personnel.

3.5.6. Training

Training to support the running and interpretation of diagnostic test packages shall [1] be supplied during this maintenance training.

3.6. Precedence

The contents of this specification shall [1] supersede WIS Workstation requirements in any other specification references in 2.0. There are no known internal conflicts within this specification. If any are discovered, the following precedence shall [2] be applied:

a. Security-related requirements (3.1.2),
b. Requirements concerning the execution of WWMCCS applications,
c. Requirements concerning workstation performance characteristics (3.2.13)
d. Workstation hardware capacity requirements (memory, disk, keyboards, etc.),
e. Workstation hardware processing requirements (bus rates, clock rates, etc.),
f. Requirements concerning other functional characteristics (remainder of 3.1, 3.2, and 3.3), and
g. Requirements concerning quality and logistics (3.4, 3.5).

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4. QUALIFICATION REQUIREMENTS

4.1. General

4.1.1. Philosophy of Testing

The WIS Workstation is to be a Proven Non-Developmental Item (NDI) procurement, with little or no development effort required to field the equipment. Consequently, all qualification of the workstation equipment and software will be a result of the evaluation of the proposed systems during the procurement activity. Testing after contract award will be limited to TEMPEST certification testing for systems that do not have TEMPEST-certified equipment during the procurement, quality assurance testing and manufacturing screening testing during production of the equipment, and user acceptance testing prior to Government acceptance of delivered systems. The onus will be on potential vendors to prove, to the Government's satisfaction, that the proposed systems meet the requirements contained in paragraph 3.0 of this Specification during the procurement evaluation period. Other types of testing described herein are designed to check the production quality of the vendor as the WIS Workstation activity proceeds, and to ensure that the Government continues to receive the quality products bid during procurement.

4.1.2. Location of Testing

Evaluation testing as part of the procurement process shall be conducted at the WIS System Project Office (SPO) in the Development and Evaluation Facility (DEF) at Hanscom Air Force Base, Massachusetts, or other locations at Hanscom Air Force Base as indicated by the WIS SPO. Manufacturing screening and manufacturer's quality assurance testing shall be conducted at the manufacturer's facility. Government quality assurance testing on fielded equipment for reliability verification will be conducted at the WIS Operational Test Sites (OTS), which include U.S. Forces Command (FORSCOM), U.S. Tactical Air Command (TAC), and U.S. Commander-in-Chief Pacific Forces (USCINCPAC). TEMPEST certification testing will be conducted at either an approved Government facility, or by a government-approved commercial test facility. User acceptance testing will be conducted at the site procuring the subject equipment.

4.1.3. Responsibility for Tests

The WIS Workstation vendor is responsible for planning and conducting all procurement evaluation tests, TEMPEST tests, and in-house quality assurance and screening tests. The Government will be responsible for conducting quality assurance testing to verify reliability measurements of the equipment. The Government will be responsible for running user acceptance tests upon delivery of systems to a WIS site.

4.1.4. Qualification Methods

Several techniques are available for verifying that the systems meet the requirements contained in 3.0. These techniques are discussed in the following sub-paragraphs.

4.1.4.1. Inspection

Requirements qualification by inspection is the technique whereby satisfaction of the requirement can be verified by inspection of equipment, source code, and other physical manifestations of the system.

4.1.4.2. Analysis

Requirements qualification by analysis is the qualification technique whereby satisfaction of the requirement is verified by inference based on an examination and analysis of the internal structure of the system and its components.

4.1.4.3. Demonstration

Requirements qualification by demonstration is the qualification technique whereby satisfaction of the requirement can be verified by use of the system and its components.

4.1.4.4. Test

Requirements qualification by testing is the qualification technique whereby satisfaction of the requirement can be verified by stimulating the system and recording and analyzing the response of the system to that stimulus.

4.1.5. Test Levels

All Government-sponsored testing will be conducted using the integrated and installed WIS Workstation system. Vendor quality assurance and manufacturing screening testing will conducted at a level specified by the manufacturer's test plans, subject to Government approval. User acceptance testing will be conducted during system delivery and installation at the WIS sites.

4.2. Formal Tests

4.2.1. Workstation Evaluation Tests

All workstations shall be evaluated as part of the procurement process to ensure that the proposed systems meet the Government's needs as specified in 3.0. The test described herein are part of the evaluation process that will be conducted as part of the procurement process.

4.2.1.1. General Requirements Tests

The potential workstation vendor shall, as part of the WIS Workstation system evaluation during the procurement selection process, prove to the Government that the proposed system meets the requirements and general thrust of paragraph 3.0 of this Specification. Tests for specific capabilities that are of greater importance to the Government are described in the remaining sub-paragraphs, and shall be performed during the procurement selection process by potential workstation vendors. The vendor may use any of the methods described in 4.1.4 as a means to prove general requirements satisfaction. The Government reserves the right to require additional tests to prove to the Government's satisfaction that the proposed system does meet the requirements in paragraph 3.0.

4.2.1.2. Honeywell Interface Tests

The workstation vendor shall demonstrate through live test demonstration that the WIS Workstation VIP emulation capability works correctly over a direct connection to a WWMCCS host located at the WIS DEF. The Government will supply the WWMCCS equipment and test driver software at the DEF for use by the vendor during procurement selection activities.

4.2.1.3. LAN Interface Tests

The vendor shall demonstrate that the X.25 based LAN interface hardware meets the requirements of the physical, link, and network layers as defined in WIS-ICD-002 through live test demonstration. The Government will provide the hardware driver equipment necessary to drive the X.25 system provided by the vendor.

The vendor shall demonstrate that vendor-supplied IEEE 802.3 LAN interface systems including the TCP/IP software layer, meets the requirements of the standard through live test demonstration. The Government will provide the necessary hardware driver equipment needed to support the live test demonstration.

4.2.1.4. Software Tests

All User Services Support software shall be demonstrated during the evaluation period. The Government will supply test data files and high-level procedures indicating what functions are to be demonstrated to guide the demonstration. Access to workstation equipment shall be made available by the vendor to Government personnel for Government hands-on trials during the evaluation period.

Verification of the multi-tasking operating system shall be demonstrated, where applicable. In particular, the ability of the system to meet requirements for tasking support, security support, and user interface support shall be demonstrated during the evaluation process.

4.2.1.5. Performance Benchmark Tests

Government-supplied performance benchmark tests shall be executed on the WIS Workstation equipment to verify that the systems meet the minimum requirements contained in Table II. Ada performance benchmark software shall be executed using the supplied Ada compilation and development system to gauge and characterize the performance of the Ada compilation system, and the code produced by the system. All tests to be executed are described in Appendix IV, "Performance Benchmark Testing." All software will be supplied to vendors for proposal preparation purposes. All software will be recompiled and executed as part of the evaluation process at the Government's facilities.

4.2.1.6. System High Security Tests

The potential workstation vendor shall, as part of the WIS Workstation system evaluation during the procurement selection process, prove to the Government that the proposed system meets the requirements and general thrust of Appendix V paragraph 50.1 of this Specification. Tests shall be performed during the procurement selection process by potential workstation vendors. The vendor may use any of the methods described in 4.1.4 as a means to prove security requirements satisfaction. The Government reserves the right to require additional tests to prove to the Government's satisfaction that the proposed system does meet the requirements in Appendix V paragraph 50.1.

4.2.1.7. Limited Multi-Level Security Tests (GRAY)

The potential workstation vendor shall, as part of the WIS Workstation system evaluation during the procurement selection process, prove to the Government that the proposed system meets the requirements and general thrust of Appendix V paragraph 50.2 of this Specification. Tests shall be performed during the procurement selection process by potential workstation vendors. The vendor may

use any of the methods described in 4.1.4 as a means to prove security requirements satisfaction. The Government reserves the right to require additional tests to prove to the Government's satisfaction that the proposed system does meet the requirements in Appendix V paragraph 50.2.

4.2.2. TEMPEST Tests

The vendor shall perform tests to certify that all equipment that is proposed to meet requirements for TEMPEST equipment, does in fact meet the emissions requirements of NACSIM 5100A necessary for TEMPEST certification, in accordance with a test plan that meets the requirements of NACSIM 5100A and is approved by the Government. These tests need be performed only for those items that are not TEMPEST-certified at time of proposal. All items (TEMPEST and non-TEMPEST) shall be scanned for emissions levels in accordance with a test plan developed in conformance to the requirements of NACSIM 5100A.

4.2.3. User Acceptance Tests

User acceptance testing will be performed as part of the equipment delivery and installation process prior to Government acceptance of the equipment. The vendor shall provide a set of procedures that can be used by the Government to judge the adequacy of the system after delivery and installation are complete. Execution of the tests shall provide a high degree of assurance that damage to the equipment and software did not occur during the transit and installation processes.

4.2.4. Quality Assurance Tests

The vendor shall have a quality assurance test plan that provides a high degree of confidence that only equipment meeting vendor's standards are delivered to the Government. The plan shall also address how the vendor will ensure that all software supplied with a workstation system is correctly installed prior to shipment.

4.2.5. Manufacturing Screening Tests

The workstation vendor shall have implemented a manufacturing screening test plan that ensures that quality parts are delivered to the vendor's facility and installed into a WIS Workstation. Tests that are used to screen components received from sub-contractors, as well as parts built in vendor facilities, shall be implemented.

4.3. Formal Test Constraints

All tests requiring external connections to non-workstation equipment (WWMCCS host, LAN equipment, etc.) will be required to be performed at the WIS DEF. All test scheduling will be required to fit within the scheduling constraints of the WIS DEF, when DEF resources are required for the tests. Vendors shall make arrangements for access to the DEF if required for pre-proposal testing and demonstration development. Time will be made available during the evaluation period for vendors to demonstrate proposed systems.

The vendor shall provide any special equipment deemed necessary by the vendor to show compliance with the specification requirements outside of the external systems already supplied by the Government.

4.4. Qualification Cross Reference

This paragraph is consider to be not applicable to this specification because of the Proven NDI nature of the equipment and software.

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5. PREPARATION FOR DELIVERY

5.1. General

All hardware, software, and data items shall [1] be prepared for delivery using standard commercial packaging and labeling techniques.

5.2. Hardware

All hardware components of each workstation (e.g. Processor, Display, peripherals, cables) shall [1] be packaged as a unit. A packing list to include item identification, description, model and serial number as appropriate for each item shall [2] be packed with each workstation unit.

5.3. Software

All software products (e.g. spreadsheet, word processing, graphics package) shall [1] be prestored and tested on the workstation hard disk before shipment. Backup, vendor-supplied master copies of all software products shall [2] be bundled for shipment as a package with each workstation. Each backup software package shall [3] be marked with the model and serial number of the Workstation for which it is backup.

5.4. Data

Data items associated with each workstation configuration (e.g. Operations Manuals) shall [1] be bundled for shipment as a package with each workstation. Each data package shall [2] be marked with the model and serial number of its associated Workstation.

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6. NOTES

6.1. Acronyms

ASCII	American Standard Code for Information Interchange
AMH	Automated Message Handler
AMHS	Automated Message Handling System
ANSI	American National Standards Institute
ADP	Automatic Data Processing
AUTODIN	Automated Data Interchange Network
CC/SM	LAN Control Center and Security Monitor
CLS	Contractor Logistics Support
DDN	Defense Data Network
DMA	Direct Memory Access
FD	Functional Description
GIPSY	Graphical Information Presentation System
GKS	Graphical Kernel System
GOSIP	Government Open Systems Interconnection Profile
ICMP	Intercomputer Message Protocol
IEEE	International Society of Electrical and Electronic Engineers
IP	Internet Protocol
ISO	International Standards Organization
LAN	Local Area Network
LAN CC/SM	WIS LAN Control Center and Security Monitor
JCS	Joint Chiefs of Staff
JDSSC	Joint Deployment Software Support Center
JMPE	Joint Mission Processing Environment
JOPES	Joint Planning and Execution System
JWIS	Joint WWMCCS Information System
MROC	Message Handling Required Operational Capability
NBS	National Bureau of Standards
NCA	National Command Authorities
OCR	Optical Character Reader
OJCS	Organization of the Joint Chiefs of Staff
OSI	Open Systems Interconnection
O/S	Operating System
RFC	Request for Comment

ROC	Required Operational Capability
S/C-U	Service/Command-Unique
SAP	Service Access Protocol
TCP	Transport Control Protocol
VIP	Visual Information Presentation
WINCS	WWMCCS Interconnection Communications System
WIS	WWMCCS Information System
WISNAS	WIS Network Authentication Service
WWMCCS	World Wide Military Command and Control System
WWS	WIS Workstation

6.2. Glossary

Binary File Transfer: A method of transferring files where the status of the eighth bit of a byte is preserved during the transfer, and where normal control processing as indicated by special ASCII character sequences is suspended or in some manner circumvented through the use of special protocols to flag control characters as data instead of control. This type of transfer is contrasted to normal ASCII transfers where the eighth bit status is not necessarily preserved (the ASCII standard requires only seven bits), and the data characters are restricted to a subset of the total 128 possible ASCII codes. The binary file transfer scheme is used to pass object code, native mode files, and other "binary"-based data between the workstation and host. In these instances, it is crucial that the status of the eighth bit be correct, and the transfer process not be interrupted by what would seemingly be control sequences, when in actuality the sequences reflected data to be transmitted.

Built-in Test Capabilities: Any combination of hardware and/or software features of the production system that detect and isolate system faults during normal operation of the system, and that do not require the inclusion of specialized equipment or software specifically designed for fault detection and isolation.

Disk Partitions: A disk partition is a contiguous subset of the addressable space contained within physical disk media that is supported by the operating system as if it were a physical disk volume. It is required that physical disk volumes be capable of being partitioned into smaller subsets by the WIS Workstation operating systems.

Disk Volumes: A disk volume is the total set of physically addressable space contained within the actual disk media.

Failure : The inoperable state in which the failed item does not or would not have the specified mission capability.

Fraction of Failures Detected (FFD) : A measure of the effectiveness of detecting system failures during operating checkout: the number of failures which are detected during operating checkout divided by the total number of failures.

Integrated Software Suite: A software environment which consists of functional modules such as word processing, spreadsheets, database management, that have been created to work together as an integrated system. Characteristics that indicate the degree of integration include:

a. Consistency of the user interface across different functional modules,
b. Capabilities to pass and incorporate data from one module to the next, and
c. Ability to move between various modules.

Integration of the required functions can occur through the use of a monolithic software package, or through the use and enforcement of a standardized environment (such as an operating system) that provides the integration function.

Line Replaceable Unit (LRU) : An item which is to be functionally isolated and physically removed during organizational (i.e., on-site, or equipment) maintenance and which consists of one or more modules.

Lockable Storage Units: Removable units (see below) that are physically restrained from removal by the use of a physical locking mechanism. The intent is to provide a means to easily remove storage units only by authorized security personnel. Normal users should not be permitted to remove these units. To qualify as removable units, removal times for these units shall be no more than one (1) minute, and shall not require removal of the case or require violation of TEMPEST shielding integrity to remove the unit. Lockable units require that the units shall not be removable except by use of a key or similar locking mechanism entrusted to authorized personnel.

Mean Time Between Corrective Maintenance Actions (MTBCMA) : A measure of system reliability related to demand for corrective maintenance manpower: the total amount of mission time divided by the total number of corrective maintenance actions.

Mean Time Between Critical Failure (MTBCF) : A measure of mission reliability: the total amount of mission time divided by the total number of critical failures during the mission. A critical failure is a failure or a combination of failures that prevents an item from performing its specified mission.

Mean Time Between False Alarms (MTBFA) : The total amount of mission time divided by the total number of failures which are detected when no failures exist.

Mean Time to Repair (MTTR) : A measure of maintenance time on equipment only: the sum of repair time divided by the total number of failures. Repair time includes isolation, removal, replacement, alignment, and checkout; but not the time required for maintenance personnel to arrive at the site, or spare supply times.

Module: The smallest item (MIL-STD-280A) which can be physically removed without cutting, unsoldering, or destructively breaking connections or interfaces.

Newly Designed or Modified Item : An item which does not meet any part of the definition for a Proven NDI item.

Pattern Failure : Multiple failures of the same type (same symptom and same cause) and where the frequency exceeds expectations. Multiple occurrences having the same symptom are assumed to be pattern failures until proven otherwise.

Process Isolation: A characteristic of computer processors that supports the differentiation of tasks or processes based on the memory that can be accessed, and the instructions that can be executed by the task or process. The processor provides a capability to "tag" tasks or processes with certain rights with regard to the accessible memory permitted the task, and the subsets of the instruction set that can be executed by the task. Normally, a hierarchy is enforced whereby application programs are given the most restricted set of rights, and the operating system kernel code all rights. This characteristic of a processor permits the separation of operating system kernel code and data from contamination and corruption by application code and data, and enhances the overall security of the system.

Proven Non-Developmental Item (NDI) : The term "Proven Non-Developmental Item", (NDI), is defined as a hardware or software item that has been produced by a contractor and is available for sale, that requires no additional design or development to meet required specifications, and which has meaningful performance, reliability, supportability and maintenance data proven by substantial use. Substantial use includes (1) typically 100,000 combined hours of use of several items or instances of items, (2) at

performance comparable to that specified, (3) with verifiable failure and repair records, and (4) with maintenance procedures, test equipment, and replacement units, repair turnaround times, and an established support structure which are comparable to the specified maintenance concept.

Removable Storage Units: Storage units that are easily removed from the system and can be locked up in a safe to provide physical protection of the data and programs contained within the unit. To qualify as a removable unit, the storage units shall take no more than one (1) minute to disconnect and remove the unit. Removal of the unit shall be accomplished without requiring removal of the system case, or violation of TEMPEST shielding integrity when removing the unit. Examples of acceptable removable techniques include: removable cartridges, fixed disk media units that slide into the system unit with suitable fastenings to keep the unit in place while in use, externally mounted disk units that connect to the system via cables, etc..

Session-Level Window: A window activated by the user to start the execution of an application program, system utility, operating system facility, or other executable program units. Session-level windows from the base window for communication with programs. Sub-windows may be activated as a result of the execution of the program.

Shop Replaceable Unit : That unit replaced in the intermediate (or depot) shop and processed for repair or further disposition.

Task: The basic unit of processor and operating system scheduling that is capable of consuming system resources including CPU time, memory, and peripheral resources. A task represents a unit of work that must accomplished by the system, and that must be scheduled to receive its share of system resources in order to perform that work.

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10. Appendix I - Block A Common User Early Products Workstation

Table 10.1 contains a list of the hardware associated with the Block A Early Products Workstation developed and deployed under contract F19628-84-C-0159, referred to as the Common User Contract (CUC), with the IBM Corporation. This workstation is the system currently in use at WWMCCS sites worldwide, and forms the system from which data files and some programs must be migrated to the WIS Workstation.

Table 10.1

IBM CUC Early Products Workstation Hardware (One-Box System with Removable Disk Drives)

Base Computer:	IBM 3270 PC/XT
Memory:	256 KB on PC/XT System board 384 KB on SlotSaver Adapter Card (see below)
Video:	IBM 3270 XGA Adapter with All Points Addressable Graphics IBM 3270 Color Monitor IBM 3270 Monochrome Adapter IBM 3270 Monochrome Monitor
Disk Storage:	(1) IBM 360KB 5.25" Floppy Disk Drive (1) IBM Floppy Disk Controller (2) Syquest 5 MB Removable Hard Disk Drives (*) (2) Syquest 10 MB Removable Hard Disk Drives (*) (1) Adaptec Hard Disk Drive Controller (*) depending on model, either 5 or 10 MB drives included
Keyboard:	IBM 3270 PC/XT Keyboard modified to meet ANSI X4.14 standard 122 Keys, 24 programmable function keys
Interfaces:	(1) Frontier ADCOM 2-M Serial Card -- MIL-STD 188C synchronous port -- Configurable asynchronous port (1) RS-232 asynchonous port (see SlotSaver) (1) Centronics parallel port (see SlotSaver)
Other Features:	RS-170A Slave Video Port (on video card) SlotSaver Adapter Card -- 384KB of memory -- Clock -- 1 serial/1 parallel port -- Keyboard Interface

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20. Appendix II - Block A Common User Release 1 Workstation

Table 20.1 contains a list of the hardware associated with the Block A Release 1 Workstation developed and deployed under contract F19628-84-C-0159, referred to as the Common User Contract (CUC), with the IBM Corporation. This workstation hardware provides the operating base for the WIS AMH Application software package that is required to be supported by all of the WIS Workstation configurations.

Table 20.1

IBM CUC Block A Release 1 Workstation Hardware

Base Computer:	IBM PC/AT Model 4459 (WIS modifications)
Memory:	256 KB on PC/XT System board 2 MB on IBM XMA Card
Video:	IBM EGA Adapter Card IBM EGA Color Monitor IBM Monochrome Adapter Card IBM Monochrome Monitor
Disk Storage:	(1) IBM 360KB 5.25" Floppy Disk Drive (1) IBM PC/AT Hard/Floppy Disk Controller (2) Syquest 10 MB Removable Hard Disk Drives (*) (1) Adaptec Hard Disk Drive Controller
Keyboard:	IBM Enhanced PC/AT Keyboard modified to meet ANSI X4.14 standard 101 Keys, 12 programmable function keys
Interfaces:	(1) Frontier ADCOM 2-M Serial Card -- MIL-STD 188C synchronous port -- Configurable asynchronous port (1) RS-232 asynchonous port (1) Centronics parallel port (1) IBM Real-time Interface Coprocessor (RIC) card for LAN Interface (modifed IAW ICD-002)
Other Features:	RS-170A Slave Video Port (on video card)

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30. Appendix III - Block A Common User Commodity Software

Table 30.1 contains a list of the commodity software supplied as a part of both the Early Products Workstation and the Release 1 Workstation. This software was delivered as one of the tasks under contract F19629-84-C-0159 (the Common User Contract) with the IBM Corporation. All WIS Workstations are required to support the execution of this software (see 3.1.4). WIS Workstation User Services Support software must be able to read and write data files compatible with versions of the data files produced by these software packages.

Table 30.1

IBM CUC Early Product Workstation Software

Operating System:	IBM PC-DOS Version 2.1 (3.3) 3270 Workstation Control Program (2.1) 3270 Workstation Program (1.1) (for AT workstations)	IBM Corporation
Word Processor:	Visiword	Paladin Software
Database Manager:	DataEase	Software Solution, Inc.
SpreadSheet:	InteCalc	Triumph Inc. (ex-Schuchardt Software Systems)
Business Graphics:	Energraphics	Enertronics, Inc.
Project Management:	Decision Support System	General Software Corp.
DOS Interface Package:	Intemate	Triumph Inc. (ex-Schuchardt Software Systems)

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40. Appendix IV - Performance Benchmarks

This appendix describes the systems and software used to determine the performance requirements contained in paragraph 3.2.13.

40.1. Benchmark Software

The suite of software issued by the Performance Issues Working Group (PIWG) of the SigADA technical committee of the Association for Computing Machinery (ACM) was chosen as the base for the WIS Workstation performance benchmark suite. The disk I/O tests were generated by the Government from sample software provided as part of the PIWG software suite.

All the benchmark software is written in Ada. Using Ada-based benchmark software provides two benefits for the WIS Workstation procurement process. First, the software measures performance under conditions that exercise both the underlying hardware, and the Ada support environment that will be used to develop WIS Workstation applications. Second, the performance benchmark tests exercise the Ada compiler and provide insight into the operation of the compiler and its use.

Table II contains the benchmark programs that must be executed and resulting performance requirements that must be met to satisfy the requirements or paragraph 3.2.13. In addition, other components of the PIWG suite will be compiled and executed (where indicated) in order to characterize the object code produced by the compiler, and determine the limits of the complexity of the code that can be successfully be compiled. Table 40.1 lists the additional components that will be compiled and executed as part of the compiler characterization evaluation.

40.2. Benchmark Development System

The Ada compiler system used for the benchmark software was the Alsys Ada compiler, version 1 3 All executable programs were developed, compiled, and built using a Zenith Z-248 system as the compilation system. The Zenith version of the MS-DOS operating system (version 3.1) was used as the base system for the development of all benchmarking test software.

40.3. Basic Workstation Benchmark System

The Basic Workstation performance requirements contained in Table II were derived from executing the requisite software on the system described in Table 40.2. The system is based on an IBM PC/AT with stock PC/AT components as delivered by IBM. The system was upgraded with an Intel Inboard 386 accelerator card with three (3) megabytes of memory included. The optional 80387 numeric co-processor was also installed and used during the performance benchmark measurement.

The Inboard 386 accelerator card possess the capability to execute at both 8 MHz and 16 MHz, with an option to enable the built-in memory caching scheme at each speed. For the Basic Workstation, the Inboard 386 system was executed using the 8 MHz mode with memory caching disabled. The IBM PC-DOS operating system (version 3.3) was used as the operating environment for the actual performance measurements.

TABLE 40.1
Compiler Performance Benchmark Software

Tasking Tests	PIWG "C" Tests	
	C000001	Compile/Execute
	C000002	Compile/Execute
	C000003	Compile/Execute
	PIWG "T" tests	
	T000001	Compile/Execute
	T000002	Compile/Execute
	T000003	Compile/Execute
	T000004	Compile/Execute
	T000005	Compile/Execute
	T000006	Compile/Execute
	T000007	Compile/Execute

Non-Tasking Tests	PIWG "D" Tests	
	D000001	Compile/Execute
	D000002	Compile/Execute
	D000003	Compile/Execute
	D000004	Compile/Execute
	PIWG "E" Tests	
	E000001	Compile/Execute
	E000002	Compile/Execute
	E000004	Compile/Execute
	PIWG "F" Tests	
	F000001	Compile/Execute
	F000002	Compile/Execute
	PIWG "G" Tests	
	G000001	Compile/Execute
	G000002	Compile/Execute
	G000003	Compile/Execute
	G000004	Compile/Execute
	G000005	Compile/Execute
	G000006	Compile/Execute
	G000007	Compile/Execute
	PIWG "L" Tests	
	L000001	Compile/Execute
	L000002	Compile/Execute
	L000003	Compile/Execute
	PIWG "P" Tests	
	P000001	Compile/Execute
	P000002	Compile/Execute
	P000003	Compile/Execute
	P000004	Compile/Execute
	P000005	Compile/Execute
	P000006	Compile/Execute
	P000007	Compile/Execute
	P000008	Compile/Execute
	P000009	Compile/Execute
	P000010	Compile/Execute
	P000011	Compile/Execute
	P000012	Compile/Execute
	P000013	Compile/Execute
Compiler Tests	PIWG Z-Tests	Compile

Table 40.2

Workstation Benchmark System

Base Computer:	IBM PC/AT Intel Inboard 386 Accelerator included
Memory:	640 KB on system 7 Megabytes extended
Video:	IBM EGA Adapter Card IBM EGA Color Monitor
Disk Storage:	(1) IBM 360KB 5.25" Floppy Disk Drive (1) IBM 1.2 MB 5.25" Floppy Disk Drive (1) IBM PC/AT 40 MB Fixed Hard Disk Drive (1) IBM PC/AT Hard/Floppy Disk Controller
Keyboard:	IBM Enhanced PC/AT Keyboard 101 Keys, 12 programmable function keys
Interfaces:	(1) RS-232 asynchonous port (1) Centronics parallel port

40.4. Target Workstation Benchmark System

The Target Workstation performance requirements contained in Table II were derived from executing the requisite software on the system described in Table 40.2. The system is based on an IBM PC/AT with stock PC/AT components as delivered by IBM. The system was upgraded with an Intel Inboard 386 accelerator card with three (3) megabytes of memory included. The optional 80387 numeric co-processor was also installed and used during the performance benchmark measurement.

The Inboard 386 accelerator card possess the capability to execute at both 8 MHz and 16 MHz, with an option to enable the built-in memory caching scheme at each speed. For the Target Workstation, the Inboard 386 system was executed using the 16 MHz mode with memory caching enabled. The IBM PC-DOS operating system (version 3.3) was used as the operating environment for the actual performance measurements.

50. Appendix V - Security Requirements for the WIS Workstation

This Appendix presents and discusses the WIS Workstation security requirements for both System High WIS Workstations, and Controlled Mode WIS Workstations. The System High requirements are derived from several sources including:

a. "The Department of Defense Trusted Computer Security Evaluation Criteria," [DoD 5200.28-STD], and

b. "Security Requirements for System High and Compartmented Mode Workstations," DIA Document DDS-2600-5502-87.

The System High requirements contained herein are considered the minimum necessary to allow WIS Workstations to exist as System High cleared processing nodes for WIS sites. The Controlled Mode requirements are taken from the Compartmented Mode Workstation requirements in the DIA report listed above, and, in conjunction with a B2 evaluation based on DoD 5200.28-STD, are considered the minimum necessary requirements for supporting limited multi-level secure (i.e., "Controlled" mode) operations using WIS Workstation systems.

50.1. Security Requirements for System High Workstations

The entire WIS will be initially accredited to operate in the System High mode. The WIS workstation must have the appropriate security controls to operate in this environment.

The System High WIS Workstation must meet two basic functional security objectives:

a. There must be a means to implement a discretionary access control mechanism that controls access of individual users to objects (e.g., files and devices) on the workstation; and

b. There must be a mechanism for declassifying the workstation.

Specific requirements designed to ensure that these overall objectives for System High Workstations are met are contained in the following sub-paragraphs.

50.1.1. Access Controls and Labels

50.1.1.1. Discretionary (Need-to-know) Access Control

The following requirements are taken from the C2 evaluation criteria contained in DoD 5200.28-STD It is the intent that the multi-tasking operating systems file management subsystem provide much of the functionality contained within this paragraph.

The security-related software shall [1] define and control access between named users and named objects (e.g., files and programs) in the workstation. The enforcement mechanism (e.g., self/group/public controls, access control lists) shall [2] allow users to specify and control sharing of those objects by named individuals, or defined groups of individuals, or by both. The discretionary access control

mechanism shall [3], either by explicit user action or by default, provide that objects are protected from unauthorized access. These access controls shall [4] be capable of identifying a single user. Access permissions to an object by users not already possessing access permission shall [5] only be assigned by authorized users.

50.1.1.2. Object Reuse

This is the object reuse requirement from DIA's requirements for System High Workstations and is consistent with the C2 requirements of DoD 5200.28-STD.

When a storage object is initially assigned, allocated, or reallocated to a subject from the system's pool of unused objects, the security-related software shall [1] assure that the object contains no data for which the subject is not authorized. When memory objects are allocated for use by a process at run-time, the memory shall [2] be cleared before the process can read it. Any portion of a file object that has not been previously written to shall [3] either: 1) not be readable by any process or 2) shall be cleared before it can be read.

50.1.1.3. Information Labels

These requirements are taken from DIA's Requirements for System High Workstations and from the recommendations from the Security Technical Committee. This requirement may be met by security-relevant software in the applications instead of by the workstation itself.

The security-related software shall [1] associate information labels with each subject and storage object requiring security protection (e.g., process, file, segment, device). The following requirements must be met to support the processing of information labels:

a. The information labels shall [2] represent the security level, code words, dissemination and control markings, and required handling caveats of objects with which they are associated;

b. The information labels shall [3] be associated with information being exported;

c. Human-readable information labels shall [4] be associated with human-readable output;

d. In order to input non labeled data, the security-related software shall [5] request and receive from an authorized user the information label of the data. All such actions shall [6] be auditable by the security-related software;

e. In order to change the information label, the security-related software shall [7] receive the changed information label from a user who has authority to change the information labels; and

f. Removable information storage media shall [8] bear external information labels indicating the security classification of the information, and applicable associated security markings such as handling caveats and dessemination limitations. Examples of such media include magnetic tape cartridges and cassettes, removable disks, disk cartridges, archival disk packs, and diskettes.

The security level portion of the information label is intended to represent the actual classification of the data as opposed to the system high sensitivity level (unless that is the actual classification).

50.1.1.3.1. Window Labels

After login, all users shall [1] access the workstation via labeled windows. Windows shall [2] be labeled with an information label at least as high as the sensitivity of the information currently being displayed in the window. Users shall [3] be able to view the information label of each window at any time. The security-relevant software shall [4] assure that each window is labeled with the system high sensitivity level before allowing a process to write the window. A privilege shall [5] be required by a process in order for that process to override this automatic setting of the window information label (i.e., to be able to set the information label of a window to which it can write).

50.1.1.3.2. Interwindow Data Moves

When moving data between windows that do not have the same information label, the security-relevant software shall [1] determine the following before allowing the move: 1) that the requesting user is authorized to perform the interwindow moves that involve different information labels, 2) that the user is cognizant that the windows have different information labels, and 3) whether the "from" window label, the "to" window label, or another user-provided label correctly represents the information label of the data being moved, by receiving such information from the user.

50.1.1.3.3. Input Labels

The security-relevant software shall [1] maintain an information label that represents the sensitivity of the data being entered by the user -- an "input information label." The user shall [2] be able to view and change the input information label at any time data can be entered.

50.1.1.3.4. Printed Output Labels

Printed output shall [1] be surrounded by banner pages that contain both the system high sensitivity level and an information label that is either: 1) provided by a user, or 2) provided by the process producing the output. The system high sensitivity level and access-related markings from the information label shall [2] appear in a statement warning that all output from the system must be protected at the system high sensitivity level and with the access-related markings from the information label until it is manually reviewed and downgraded. The information label shall [3] appear as an advisory information label on the banner pages. The top and bottom of each page (exclusive of the banner pages) shall [4] contain the information label.

50.1.2. Accountability

50.1.2.1. User Identification and Authentication

The first paragraph is taken from the C2 evaluation criteria of DoD 5200.28-STD. The remaining requirements are taken from DIA DDS-2600-5502-87, "System High Workstations".

The security-related software shall [1] require users to identify themselves to it before beginning to perform any other actions that the security-related software is expected to mediate. The security-related

software shall [2] use a protected mechanism (e.g., passwords) to authenticate the user's identity. The security-related software shall [3] protect authentication data so that it cannot be accessed by any unauthorized user. The security-related software shall [4] be able to enforce individual accountability by providing the capability to uniquely identify each individual workstation system user. The security-related software shall [5] provide the capability of associating this identity with all auditable actions taken by that individual.

If passwords are the authentication mechanism for the workstation, the authentication data shall contain a one-way encrypted value based on the user's password. When a user enters his password, it is used to construct an identically encrypted value in the authentication data. The authentication data shall [6] be protected so that it cannot be accessed by any unauthorized user.

50.1.2.1.1. Password Generation

Passwords shall [1] either be chosen by an automatic password generation program, or selected by the WASSO. Passwords shall [2] always be at least six (6) characters in length. The security-relevant software shall [3] require users to change their passwords with a frequency selectable by the WASSO. The security-relevant software [4] shall notify users when passwords are to expire prior to the actual expiration date. The security-relevant software shall [5] notify users when the password has been changed, if changed by the WASSO. If the automatic password generation option is supported, the security related software shall [6] perform all password changes by generating a random, pronounceable password, and assigning it to the user.

50.1.2.1.2. Storage of Authentication Data

The authentication data may either be stored locally on the workstation or may be resident on some other node in the network to which the workstation is attached. If the authentication data is stored locally on the workstation, the authentication data shall [1] be stored locally on a storage medium that cannot be physically removed from the workstation by unauthorized users. If an approved non-local host is selected as the repository of authentication data, the workstation shall [2] provide the capability to either automatically switch to a locally stored copy of the authentication data, or suspend operation until an external authentication host becomes available, in the event that the external authentication host becomes inoperable.

50.1.2.2. Audit

This requirement is the B1 requirement from DoD 5200.28-STD for audit.

The security-related software shall [1] be able to create, maintain, and protect from modification or unauthorized access or destruction, an audit trail of accesses to the objects it protects. The audit data shall [2] be protected by the security-related software so that read access to it is limited to those who are authorized for audit data. The security-related software shall [3] be able to record the following types of events: use of identification and authentication mechanisms, introductions of objects into a user's address space (e.g., file open, program initiation), deletion of objects, and actions taken by computer operators and system administrators and/or WASSOs. For each recorded event, the audit record shall [4] identify: date and time of the event, user, type of event, and success or failure of the event. For identification and authentication events the origin of request (e.g., terminal ID) shall [5] be included in the audit record. For events that introduce an object into user's address space and for object deletion events the audit record shall

[6] include the name of the object and the object's security level. The WASSO shall [7] be able to selectively audit the actions of one or more users based on individual identity and/or object security level. The security-related software shall [8] be able to audit the override of human-readable output markings.

50.1.2.2.1. Storage of Audit Data

This requirement is from the DIA DDS-2600-5502-87 requirements for System High Workstation audit capabilities.

The audit data may either be stored locally on the workstation or may be resident on some other node in the network to which the workstation is attached. If the audit data is stored locally on the workstation, the audit data shall [1] be stored locally on a storage medium that cannot be physically removed from the workstation by unauthorized users. If an approved non-local host is selected as the repository of audit data, the workstation shall [2] provide the capability to either automatically switch to a locally stored copy of the audit data, or suspend operation until an external audit host becomes available, in the event that the external audit host becomes inoperable.

50.1.3. Operational Assurance

50.1.3.1. System Architecture

The security-related software shall [1] isolate the resources to be protected so that they are subject to the access control and auditing requirements. The security-related software shall [2] execute in its own hardware execution domain, and shall [3] use the hardware-provided features to prevent itself or its data from being unintentionally or maliciously modified. The security-relevant software shall [4] isolate the resources to be protected so that they are subject to the access control and auditing requirements.

50.1.3.2. System Integrity

This requirement is taken from the DIA requirements for System High workstations.

The WIS Workstation hardware, firmware, and/or operating system shall [1] assure that the correct copy of the operating system is "booted" during system startup. If the boot procedure allows the name of the system to be "booted" to be entered by the user, then the WWS shall [2] accept and validate a password from the user via the system console before "booting" the system, or shall [3] boot only a predetermined copy of the operating system.

After the operating system is loaded from disk but before it begins normal operation, it shall [4] prompt the user for a login name and password. If the operating system cannot authenticate the user in this manner as one authorized to boot the system, it shall [5] immediately halt the system. If the user is properly authenticated, the system shall [6] be booted. Note that this authentication of the user booting the system does not imply that the user is logged on.

50.1.4. Life Cycle Assurance

50.1.4.1. Security Testing

This requirement is from the C2 evaluation criteria requirement of DoD 5200.28-STD.

The security mechanisms of the WIS Workstation shall [1] be tested and found to work as claimed in the system documentation. Testing shall [2] be done to assure there are no obvious ways for an unauthorized user to bypass or otherwise defeat the security protection mechanisms of the WIS Workstation. Testing shall [3] also include a search for obvious flaws that would allow violation of resource isolation, or that would permit unauthorized access to audit or authentication data.

50.2. Security Requirements for Controlled Mode Workstations (GRAY)

This section discusses the capabilities of the Compartmented Mode Workstation as contained in DIA document DDS-2600-5502-87, "Security Requirements for System High and Compartmented Mode Workstations", that will be required for WIS Workstations to support target Block B limited multi-level (i.e. "controlled mode") secure processing configurations. The capabilities discussed in this appendix are in addition to the requirements of DoD 5200.28 class B2 evaluation.

The material presented in this appendix is necessarily brief. For more detailed information on the requirements and rationale for the Compartmented Mode Workstation, refer to DIA publication previously referenced.

The Compartmented Mode Workstation (CMW) requirements are designed to provide a multi-level secure environment for intelligence workstations that must deal with data classified not only by level, but also through a compartmentation policy. While the WIS will not have to handle compartmented secure data, the CMW definition does provide additional security requirements for labeling, access paths, and facility management that, while not specifically covered by the B2 evaluation criteria, are, nevertheless, desirable for inclusion into the WIS Workstation definition to enhance the capabilities of the workstation to support secure data processing.

50.2.1. Labeling

To support effective control over the modification and access of protected data, labeling management must be implemented as part of a CMW compliant operating system. Security-related operating system software shall [1] associate security information labels with all objects that can contain classified data and thus require security protection. Such objects include but are not limited to: processes, disk files, devices, windows, and data entered through user input processing. Requirements for information labeling include the following general capabilities:

a. The labels shall [2] represent the security level (classification and special access categories), code words, and required handling caveats of objects to which the labels are associated;

b. The labels shall [3] be associated with information being exported;

c. Human-readable labels shall [4] be associated with human-readable output;

d. In order to import non-labelled data, the security-related software shall [5] request and receive from an authorized user the security level of the data, and all such actions shall [6] be auditable;

e. In order to change the information label, the security-related software shall [7] receive the changed information label from a user who has special authority to change the sensitivity labels; and

f. Removable information storage media shall [8] bear external information labels indicating the security classification of the information, and applicable associated security markings such as handling caveats and dessemination limitations. Examples of such media include magnetic tape cartridges and cassettes, removable disks, disk cartridges, archival disk packs, and diskettes.

The above requirements state general capabilities that must be supported by a CMW-compliant operating system. Specific requirements for various operating system "objects" (e.g., processes, windows, devices, files, etc.) are discussed in the following sections.

50.2.1.1. Process Data Information Labels

Each operating system process shall [1] have an information label, called a process data information label (PDIL), that represents the sensitivity of the data it has read or executed. When a process reads an object, the PDIL shall [2] "float up" to accommodate the information label of the object. Only specifically identified, documented, and privileged processes shall [3] possess the capability to override the automatic setting of the PDIL.

50.2.1.2. Window Information Labels

After login, access to the CMW shall [1] occur through a labelled window only. Windows shall [2] be labelled with an information label at least as high as the sensitivity of the information currently displayed in the window. The information label for each window shall [3] be viewable at any time. If a window contains no data, the window information label shall [4] incorporate the system low information label and the system low markings. The window information label shall [5] "float up" to accommodate the PDIL of each process that writes data to the window. The CMW operating system software shall [6] require the process to possess an appropriate privilege to override this automatic setting of the window information label. The CMW operating system shall [7] possess the capability to clear the window of all displayed data, thus causing the window information label contents to be lowered to the value of the system low information label and markings.

50.2.1.3. Interwindow Data Moves

When moving data between windows that do not have the same information label or sensitivity labels, the CMW operating system shall [1] determine the following before allowing the move: 1) that the requesting user is authorized to perform the interwindow moves that involve differing information and sensitivity labels, 2) that the user is cognizant that the windows have different information and sensitivity

labels, and 3) whether the "from" window information and sensitivity labels, the "to" window information and sensitivity labels, or another user-provided information and sensitivity labels correctly represent the information and sensitivity label of the data being moved, by receiving such information from the user.

50.2.1.4. Input Information Labels

The CMW operating system shall [1] maintain an information label that represents the sensitivity of the data being entered by the user, i.e., an "input information label". The workstation user shall [2] be able to view and modify the input information label whenever data can be entered.

50.2.1.5. File Information Labels

The information label of files that contain no data shall [1] incorporate the system low information level, and system low markings. The information label on files shall [2] "float up" to accommodate the PDIL of each process that writes data to that file. The CMW operating system shall [3] require processes that wish to override this automatic setting of the file label to possess a authorization for the privilege before allowing the operation to proceed. The CMW operating system shall [4] provide a capability that allows users and processes to increase the classification level contained within the information sensitivity labels and markings associated with files to which the said users or processes have mandatory and discretionary write access privileges. The CMW operating system shall [5] ensure that the act of lowering the security labelling of a file (i.e., assigning an information label that does not dominate the original label, or, changing the markings to a set that indicate less restrictive access than the original markings) requires a user or process to possess ownership rights to the file object and the authority to perform downgrading actions.

50.2.1.6. Printed Output Labelling

Printed output shall [1] be surrounded by banner pages that contain both the sensitivity label, and the PDIL of the process producing the output. If the sensitivity level and the information level in the PDIL match, then the banner pages shall [2] contain this level as the correct label for the printed data. If the two levels do not match, the banner shall [3] include a statement warning that the output should be handled at the sensitivity level and with the access related markings from the PDIL until it is manually reviewed and downgraded. The PDIL shall [4] appear as an advisory information label on the banner page. The top and bottom of each page shall [5] (exclusive of the banner page) contain the PDIL. The CMW operating system shall [6] require a task or process to possess a privilege to override this automatic setting of internal page marking.

50.2.1.7. Network Output Labelling

Output being transmitted over limited multi-level secure mode network connections shall [1] be marked with the sensitivity label of the process producing the output. Information labels of the object(s) being output shall [2] be transmitted along with the output over all network connections.

50.2.1.8. Imported Data Labelling

To import nonlabelled data (e.g., from a tape), the CMW operating system shall [1] receive from an authorized user the information and sensitivity labels for the data, and all such actions shall [2] be auditable by the operating system.

50.2.2. Trusted Path

The CMW operating and windowing systems shall [1] support a trusted direct communication path between a workstation user and the security software for use whenever a trusted link between the security-related software and user is required (e.g. logging in, changing security levels, etc.). Communications via this path shall [2] be initiated exclusively at the request of the user or by the security-related software, and shall [3] be logically isolated and distinguishable from other communication paths.

These requirements are necessary to preclude the possibility of a user inadvertently revealing sensitive security information (such as passwords, security labelling) to software that is not security-related.

50.2.2.1. Initial Login and Authentication

The CMW operating system shall [1] provide a direct communications path between itself and the user for initial login and authentication. User processes shall [2] be prevented from reading from or writing to the screen prior to initial login and authentication. This direct communication shall [3] occur before any windows are displayed on the screen. When the CMW is first started, this direct path shall [4] be activated. After a user has successfully logged in, this direct communication path shall [5] be established only upon user request.

50.2.2.2. Access to Security Functions

The trusted path capability shall [1] be controlled by the CMW operating system after initial login and authentication, and the CMW operating system shall [2] provide the following capabilities:• provide for reserved portions of the screen to which user processes cannot write; and,• read all user input to determine whether the user is attempting to communicate via the trusted path.Furthermore, the CMW operating system shall [3] use the above mechanisms to allow the user to perform security-critical functions via the trusted path including, as a minimum, entering and changing information labels.

50.2.3. Trusted Facility Management

The security-related software shall [1] support separate operator, administrator, and security administrator functions. The functions performed in the role of an information system security officer (ISSO) shall [2] be identified. The ISSO shall [3] only be able to perform security functions after taking a distinct auditable action to assume the security role on the ADP system. Non-security related functions that can be performed in the security role shall [4] be limited to those essential to performing the security role effectively.

The CMW operating system shall ensure [5] that access to each role requires a valid login sequence be performed before allowing as user to assume the adminstration role. The functions available in each role shall [6] be restricted to the minimum necessary required functions needed to carry out the role.

50.2.3.1. Security Administrator

The CMW operating system shall [1] provide to the ISSO the mechanisms needed to assist the ISSO in carrying out the following tasks:

a. Assigning passwords and clearance levels to users;

b. Assuring proper information and sensitivity labels are present on all data in the system;

c. Assuring proper discretionary access control information is associated with all data in the system;

d. Controlling the audit mechanism;

e. Reviewing audit data; and

f. Controlling which function can be performed by the administrator, operator, and users.

50.2.3.2. System Administrator

The CMW operating system shall [1] provide to the system administrator the mechanisms needed to assist the administrator in carrying out the following tasks:

- adding and removing users from the system;
- adding and removing devices from the system;
- system configuration.

50.2.3.3. Operator

The CMW operating system shall [1] define the operator's role to be limited to responsibilities for day-to-day operation of the workstation not specifically covered in the system administrator and security administrator duty requirements, and that should not necessarily be performed by the normal user. For application to a workstation environment (which is normally assigned to specific individuals), the "owner" of the workstation would be designated as a system operator. Such responsibilities include, but are not limited to, backups, printer maintenance, device configuration (non-security related), and other such duties.

50.2.4. Trusted Recovery

Procedures and mechanisms shall [1] be provided to assure that recovery without a protection compromise is obtained, after system failure or any other discontinuity in system operation occurs.

60. Appendix VI - Power Cable Requirements for WWMCCS Sites

This appendix contains figures and diagrams outlining the plug configurations required for installing workstation and associated equipment outside the Continental United States. Table 60.1 lists the types of plugs required for various countries that can host WWMCCS and WIS sites. Figure 60.1 provides diagrams of the possible plug configurations.

TABLE 60.1

Recommended Power Plug Connections for OCONUS Sites

Country	Voltage Range 125 V	250 V	Country	Voltage Range 125 V	250 V
Argentina	4	2	Mexico	4	23
Australia	4	6	Netherlands	4	15
Austria	4	15	New Zealand	4	6
Belgium	4	15	Nicaragua	4	5
Bolivia	4	2	Norway	4	15
Brazil	4	2	Panama	4	15
Chile	4	2	Paraguay	4	2
Columbia	4	2	Peru	4	5
Costa Rica	4	2	Philippines	4	5
Dominican Republic	4	5	Portugal	4	15
Ecuador	4	5	Spain	4	15
El Salvador	4	5	Surinam	4	5
Germany	4	15	Sweden	4	15
Guatemala	4	5	Taiwan	4	5
Guyana	4	5	Thailand	4	5
Honduras	4	5	United Kingdom	4	23
Iceland	4	15	Uruguay	4	2
Italy	4	15	Venezuela	4	5
Japan	4	15			

Notes:
1. Asian and Latin American countries not listed will be shipped assemblies with plug 4 attached.
2. European, Middle East and African countries not listed will be shipped cords with plug 15 attached.

Physical Configuration of New Plugs
Pin Sid View

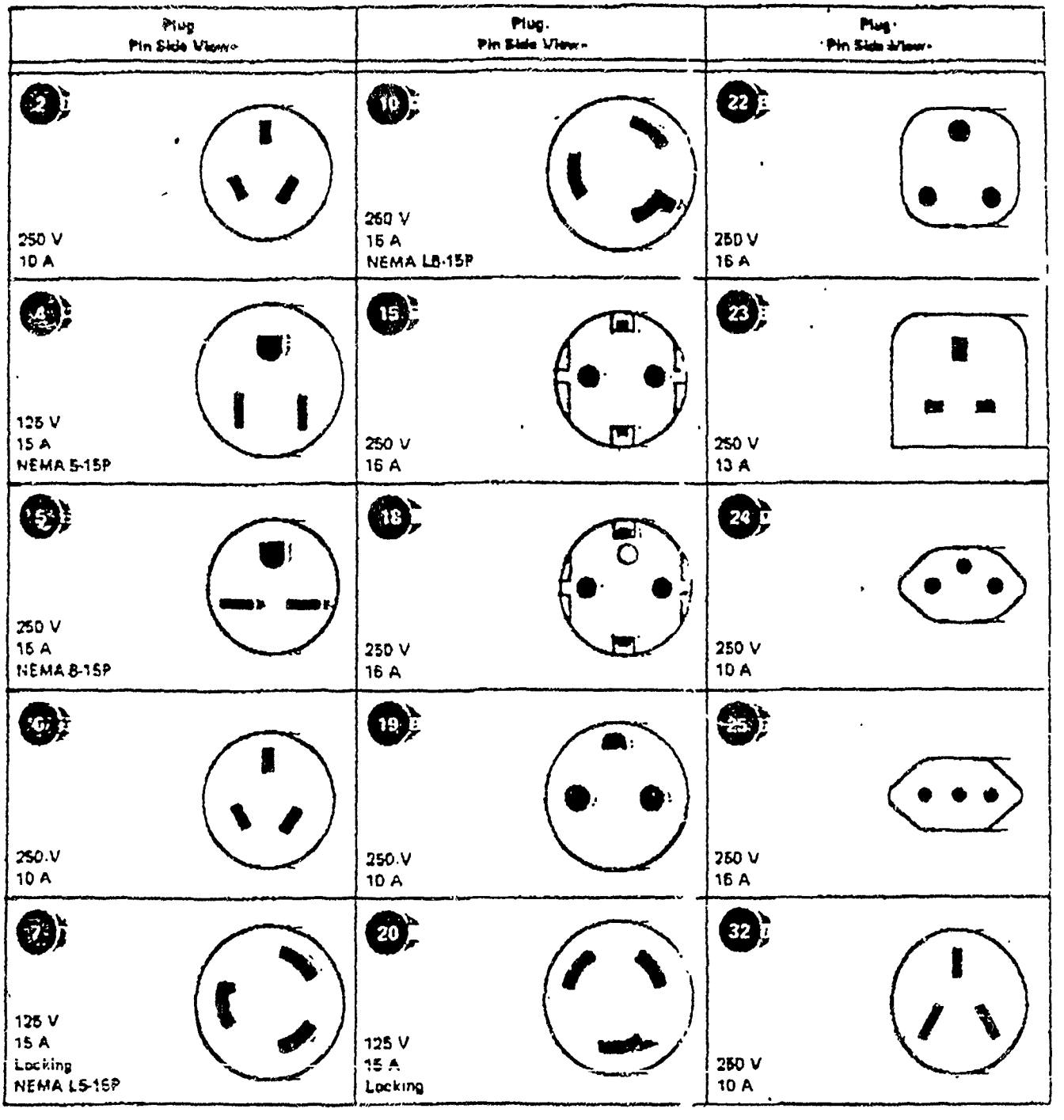

Figure 60.1

Power Plug Diagrams

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70. Appendix VII - Required Extensions to Basic Kermit Protocol

This appendix presents and discusses the minimum set of required extensions that must be present in any software implementing file transfer capabilities using the Kermit protocol on the WIS Workstations. The basic protocol and the required extensions are described in the following reference:

"KERMIT - A File Transfer Protocol," Frank da Cruz, Digital Press, 1987

and the file KER:KPROTO.DOC (current version) which is available from Columbia University. The current definitions and protocol descriptions contained in KER:KPROTO.DOC shall [1] take precedence if discrepancies occur between references. The extensions discussed herein shall [2] be implemented in accordance with all provisions of the protocols contained in the references.

70.1 Kermit at a Glance

The following table briefly describes the required scope of the software implementing file transfer capabilities using the Kermit protocol. The protocol features and options contained in this table shall [1] be implemented by all WIS Workstation software implementing the Kermit protocol.

Local Operation:	YES
Remote Operation:	YES
Transfers Text Files:	YES
Transfers Binary Files:	YES
Wildcard Send:	YES
Filename collision avoidance:	YES
Can Time Out:	YES (user settable timeout per J)
8th-bit prefixing:	YES
Repeat count prefixing:	YES
Alternate Block Checks:	Two-byte Checksum, CRC
Terminal Emulation:	Work in conjunction with VIP emulation
Communications Settings:	YES
Transaction Logging:	YES
Session Logging:	YES
Act as a Server:	YES
Talk to Servers:	YES
Advanced Server Functions:	Highly desired
Advanced Commands for Servers:	YES
Local File Management:	YES
Command/Init Files:	YES
Extended Length Packets:	YES
Sliding Windows:	YES

These topics are discussed in the references and the reader is directed to these resources for further information. The remainder of this Appendix discusses a subset of topics that are most important to the WIS Workstation program.

70.2 Extended Length Packets

The software using the Kermit protocol shall [1] implement an extended length packet option, which is negotiated at file transfer initiation and server initiation in accordance with the protocols described in the references. The software shall [2] be capable of accepting and sending packets with lengths of up to a minimum of 2048 bytes.

70.3 Sliding Windows

The software using the Kermit protocol shall [1] implement a "sliding window" facility in accordance with the protocol described in the references. The software shall [2] be capable of handling a minimum of seven (7) outstanding packets as the length of the allowable window size.

70.4 Workstation Access to Host-based Servers

The WIS Workstation software using the Kermit protocol shall [1] implement the protocol features and options necessary to support communications with a host-based Kermit server in accordance with the protocol described in the references. The following table lists the minimum packet types that shall [2] be capable of being processed by the workstation server support software, in addition to the basic packet types used for file transfers:

Packet Type	Purpose
I	Initial protocol option negotiation
X	Text Header packet (for packets to be displayed at screen)
K	Send Kermit command to host Kermit command processor
G	Generic Kermit Command packet. Associated sub-types are:
GC	-- Change directory
GL	-- Logout, Good Bye
GF	-- Shutdown server, but don't logoff host
GD	-- Host to provide directory listing
GE	-- Host to delete specified files
GT	-- Host to send file with T packet for typing at terminal
GR	-- Host to rename file
GK	-- Host to copy host file from one place to another on the host
GH	-- Host to send help on Kermit usage
GQ	-- Host to send server status to workstation

The workstation software using the Kermit protocol shall [3] provide a user interface to these capabilities, where appropriate, so that these capabilities can be used.

70.5 Workstation as Kermit Host

The Workstation software using the Kermit protocol shall [1] implement host server operations where the workstation can act as a Kermit host. All packets and options described in 70.4 shall [2] be supported by the host server software, with the workstation acting as the host server.